Pit and Quarry

With which is consolidated CEMENT-MILL & QUARRY

Member Audit Bureau of Circulations

Read in Largest Number of Plants

Vol. XXIII December 16, 1931 No. 6

Published bi-weekly on Wednesday for producers and manufacturers of Cement, Crushed Stone, Gypsum, Lime, Sand, Gravel and other nonmetallic minerals. Entered as second-class matter October 9, 1928, at the Postoffice at Chicago, Ill., under the Act of March 3, 1879.

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Vol. XXIII CHICAGO, DECEMBER 16, 1931 No. 6

Basis of New Rates Changed to Tonnage

PREVIOUS RULING MODIFIED

The Interstate Commerce Commission on December 7 withdrew its plan for pooling revenue from increases in railroad freight rates, which it suggested in its recent decision of the 15 per cent. rate-increase case.

At the same time it permitted certain increases to become effective. The commission changed its previous surcharge of $3 a car to 6 c. a ton on freight included under that classification and the $6 a car classification to 12 c. a ton. Other rates authorized to be increased remained the same as previously outlined. The revised rates as affecting the nonmetallic-mineral industries are as follows:

Increase of 6 c. per ton:

Sand (other than molding or glass)
Gravel
Stone (crushed, broken or ground)
Slag

Increase of 12 c. per ton:

Phosphate rock (crude, ground or unground)
Sulphur
Stone (rough or dressed)
Asphalt (natural-rock or by-product)
Artificial stone

The commission further decided to authorize an increase of 2 cents in all less-than-carload rates.

Milwaukee Gravel Firms Complete Consolidations

A merger of sand-and-gravel, fuel and building-material producers and dealers has been agreed upon by firms representing 60 per cent. of such business in Milwaukee county, Wis.

Articles of incorporation for the new Consolidate, to be known as the United Materials Corp., have been filed and the new firm has been capitalized at $1,500,000.

According to one of the officers of the new company the organization is expected to correct some of the "cut-throat" competition from which the sand-and-gravel business, particularly, is said to have suffered in the Milwaukee area in the last several years. It is also interpreted as a sign of confidence in the expected recovery in building.

The corporation will be the biggest distributor of building materials in Wisconsin. It is pointed out that the new Consolidate will afford member companies sounder credit rating with banks than they have enjoyed as individuals.

Sewell Lime Co. Erects New Kilns and Crushers

The Sewell Lime Co. is improving its plant located at Lime Mountain, eleven miles east of Orofino, Idaho, on a branch of the Camas Prairie Railroad. A seven-car spur track has been laid and new lime kilns and crushing machinery is being installed, according to W. E. Sewell, general manager of operations.

Canadian Gypsum Plant Adds Two New Products

Two new products—a gypsum wallboard with a wood-grain finish and a new type of acoustic tile—are soon to be produced at the New Westminster, B. C., plant of Gypsum, Lime & Alabastine, Ltd., of Canada.

Domestic business of the company has been fairly satisfactory during the past year, it is said, while exports have slumped sharply.

Norman Jessiman is general manager of the company's British Columbia operations and A. L. Dryden is superintendent of the New Westminster plant.

Phosphate-Rock Deposit in Montana to Be Mined

A huge new field of phosphate rock which will release thousands of tons for western use has been opened in Montana and arrangements have been made by Allan Swain, head of the Pacific Phosphate and Chemical Co. of Portland, Ore., to secure this supply for the use of the company. Mr. Swain, who recently returned to Portland from Elliston, Mont., states that a quarter section of land giving the only possible access to the deposits has been obtained, and that an open pit mine will be opened at once.

The Portland company is now handling 10 carloads of phosphate weekly through its new plant.

Offices of Cement Plant Moved to Portsmouth, O.

The business offices of the Superior, O., cement plant of the Wellston Iron Furnace Co., which have for many years been located at Jackson, O., have been transferred to Portsmouth, O.

New Mexican Potash Soon to Be Shipped

TWO CONCERNS IN NEW FIELD

Within the next 30 days commercial potash will be turned out for shipment from the refinery of the National Potash Co., located 18 miles east of Carlsbad in the newly discovered Eddy county potash area.

This company, the first to complete a commercial venture into these vast potash regions of the southwest, has an investment in Eddy county of approximately one million and a half dollars, according to reports.

The National Potash Co. is the surviving organization from among the many which engaged in pioneering the field and is composed in part of some units of former organizations.

The California Potash Co. has also entered the field and at present is making tests for productive locations. Its commercial activities, however, are not likely to get under way for probably another year to a year and a half, it is said.

Production from the New Mexico deposits will, it is hoped, eventually free this country of dependence on foreign countries for its domestic requirements for potash.

Closes Stone Quarry in Ohio After Busy Season

The Mt. Pleasant, O., quarry of the France Stone Co. which has operated continuously since March, part of the season operating 14 and 24 hours daily, has discontinued operations for the present season. Extensive repairs and the installing of a larger crusher will be under way for the next couple months in preparation for next season's trade. Many thousands of tons of various sizes of crushed stone are in storage from which orders will be supplied during the shut-down period.

Floyd Million and Son Reorganize Gravel Firm

The Million Sand & Gravel Co., operating for many years at Lake Cicott, Ind., has been reorganized under the laws of Indiana as Floyd Million & Son, Inc. The new set-up has been capitalized at 500 shares of $100 each.

I. C. C. Halts Attempt to Raise Class Rates

STONE AND GRAVEL AFFECTED

Efforts of Central Freight Assn. railroads to establish a higher basis of rates on dolomite, fluxing stone, agricultural limestone and gravel in carloads, between points in that territory, when the shipments move in box-cars than when moved in open-top equipment have been halted by the Interstate Commerce Commission.

The commission (I. & S. Docket 3,571) has ordered the carriers to cancel by Dec. 3 tariffs which proposed to restrict the present rates on the products mentioned to shipments in open-top equipment. Specifically, the tariffs named as points of origin Gibsonburg, Carey and Woodville, O., and Greencastle, Ind., and as destinations, Kingsport, Tenn., Pittsburgh Pa., Muncie, Ind. and other points.

They also proposed at the same time to establish rates based on 60 per cent. of sixth class when the products were loaded in box-cars, to provide for instances where no rates existed for movement in that type of car.

Protests against the proposed changes were filed with the commission by Blue Ridge Glass Corp., Kingsport, Tenn.; National Mortar & Supply Co., and American Window Glass Co., Pittsburgh, Pa.; National Lime & Stone Co., Findlay, O., and Mid-West Rock Products Corp., Indianapolis, Ind.

The tariffs were to have become effective Feb. 15, 1931, and later dates.

In its decision the commission said that the carriers contended that the present rates on the commodities involved were not uniform in central territory and that, because in certain instances the rates were restricted to box-car movements only, some producers were preferred and given undue advantage over their competitors. The railroads said if the suspended tariffs were permitted to become effective greater uniformity in the rate structure would result.

The commission pointed out, however, that no limestone producers had intervened in the case in behalf of the carriers or complained that the present rates were prejudicial to their business. On the contrary, all the protestants said the present rates were on a competitive basis which would be disrupted if the tariffs were allowed to go into effect.

The commission said it was convinced that the "piecemeal" adjustment attempted by the carriers would result in a more confused condition of the limestone rates than now exists. It pointed out that the carriers had expressed the hope that it would prescribe a reasonable basis of rates on limestone from all producing points and put them on the same level.

"This would be tantamount to a general revision of the limestone rates without notice to all producers and shippers of this commodity," the commission said. "Furthermore, respondents in this proceeding have not seriously attempted to show that the present basis of rates is lower than reasonable, but their evidence was directed mainly to showing that they should receive more for the transportation of limestone in box-cars than in open-top equipment for the reasons stated hereinbefore."

Asphalt Technologists to Meet on January 15

The meeting date of the Assn. of Asphalt Paving Technologists during the twenty-ninth annual convention and road show of the American Road Builders' Assn. has been changed from January 15 to a day earlier, January 14.

Quarry's Record Best in St. Louis District

RECEIVES PLAQUE AS AWARD

The quarry of the Missouri Portland Cement Co., St. Louis, Mo., was recently acclaimed winner of the safety contest sponsored by the St. Louis Safety Council, in which all quarries in the St. Louis area competed. The accompanying picture shows the employees of the quarry, with Harry Billman, superintendent, at the extreme right displaying the plaque awarded the company.

"The contest, extending for the first six months of the year, was based on accident-frequency rating," says Supt. Billman. "During that time our quarry, which is located nine miles from the cement plant, had no accidents. As a matter of fact, we have had but one accident since November 9, 1929. That occurred on November 8, 1930, on the very eve of an accident-free year, and was the result of a strain, which apparently occurred in stepping down from the shovel.

"Prior to November, 1929, our experience was very bad. Then all at once we began to 'click,' for some unexplained reason. Operating conditions are exactly as they have been for years. I think it shows you can get results by simply creating and sustaining an interest in safety work."

Quarry crew of the Missouri Portland Cement Co. which won the safety award in the St. Louis area.

"Phosphate" Is Name of New Station in Montana

"Phosphate" is the name of a new official stop for C. M. & St. P. Rwy. trains three and one-half miles west of Garrison, Mont. The town formerly was known as Big Bend. Phosphate rock is produced in the hills nearby and trucked to the railway spur for loading by the Wm. Anderson Phosphate Mining Co. It is hauled from there by the railroad to British Columbia, much of it going to Trail, B. C., for use in smelters there. Operations have been in progress at Phosphate for nearly two years, and about 100 men are employed.

1931 Book of Standards Supplement Is Available

The American Society for Testing Materials has issued the 1931 Supplement to the 1930 Book of A.S.T.M. Standards. The Book of Standards is issued only every third year, and the standards which are adopted by the Society in the intervening years are published in Supplements, which bring up to date both parts of the Book of Standards, namely Part I, Metals and Part II, Non-Metallic Materials.

The 1931 supplement is furnished with orders for the Book of Standards and is available separately as well, at a price of $1.50.

Fire Causes Damage at Memphis, Tenn., Plant

Fire caused $10,000 damage to the the building and equipment of the Hydro-Stone Co., makers of cast stone and concrete products, at Memphis, Tenn., recently.

Much of the loss was in the form of damage to a large number of finished pieces of cast stone awaiting delivery for use in the construction of the new U. S. Engineers Bldg., at Memphis.

Expansion of its Essexville, Mich., plant is being planned by the Aetna Portland Cement Co. O. J. Lingeman is general manager.

Road Builders Carry on Pre-Mixed Study

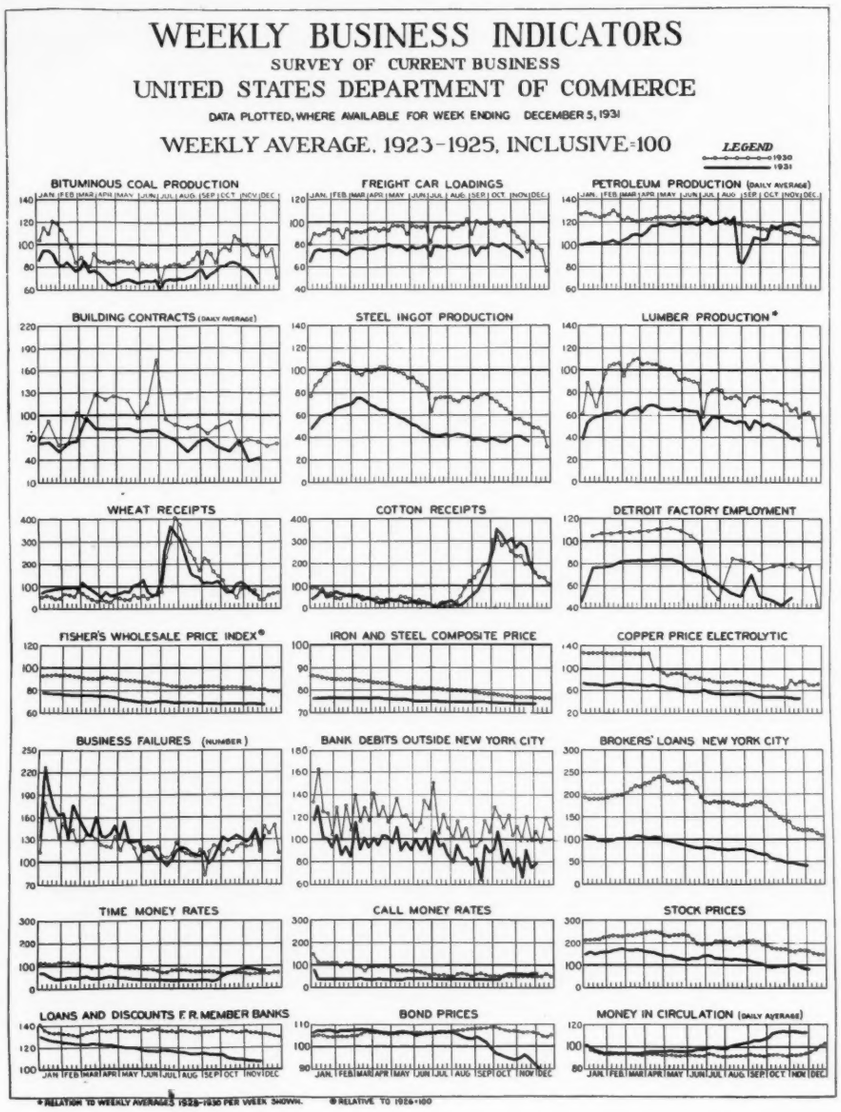
WATCH IMPROVED EQUIPMENT

The use of central- and truck-mixed concrete in highway work is being studied by the American Road Builders' Assn. in coöperation with the National Ready Mixed Concrete Assn.

The Road Builders' committee was organized in 1930 and made its first report at the 1931 convention. This report consisted of a survey of the use of central- and truck-mixed concrete in the paving industry and was instrumental in partially overcoming objections to its use.

With the organization of the National Ready Mixed Concrete Assn., and in view of the active committee work being carried on by the American Concrete Institute and the American Society for Testing Materials, the American Road Builders' Assn. planned this year to turn over its data to these organizations and discontinue the committee. However, at their request and by agreement, the association is continuing its work this year on the use of central- and truck-mixed concrete in road and street construction. It is the plan of the committee to make authoritative conclusions on the objections raised by users of this product and to assist the industry in overcoming the difficulties which they are now experiencing. Particular attention will be given to the development of equipment for transferring the pre-mixed concrete from the hauling unit to the subgrade; water control and batch meters on truck mixers; and the standardization of such mixers.

The work is in charge of R. Keith Compton, director of public works, Richmond, Va., as chairman. Other members of the committee are: R. W. Cornelisen, Lakewood Engineering Co., Columbus, O.; C. B. Bryant, engineer of materials, Maryland State Roads Commission, Baltimore; J. E. Bushnell, Ransome Concrete Machine Co., Dunellen, N. J.; Alexander Foster, Jr., Chas. Warner Co., Philadelphia, Pa.; R. T. Harris, Blaw-Knox Co., Philadelphia; H. C. Whitehurst, engineer of highways, District of Columbia; H. F. Thompson, General Materials Co., St. Louis, Mo.



Suspends Tariffs to Reweigh Loaded Cars

WILL AFFECT ALL PRODUCERS

Tariffs carrying a proposed uniform weight-tolerance rule to govern reweighing of carload-freight shipments throughout the United States have been suspended by the Interstate Commerce Commission until Aug. 1, 1932. The tariffs are B. T. Jones' I.C.C. 2434 and F. L. Speiden's I.C.C. 1475.

The proposed rule would affect shipments of sand, gravel, clay, dolomite, slag, all uncut stone, brick, and similar commodities.

The present rule provides that tolerance on these commodities shall be one per cent. of the lading, with a minimum of 500 lbs., except when the shipments are loaded in open-top cars, when it shall be one per cent. of the lading, with a minimum of 1,000 lb.

Under the proposed rule the tolerance would be changed to 1½ per cent. of the lading when shipments were loaded in open top cars, with a minimum of 500 lb.

The Indiana State Chamber of Commerce and the National Industrial Traffic League filed protests against the proposed rule and the suspension (I. & S. Docket 3654) was the result of these protests.

Protest of the Indiana State Chamber of Commerce was filed on behalf of its members who are shippers of clay, dolomite, brick, sand, gravel and the other commodities affected. The chamber said the proposed rule would work a hardship on users of these commodities and would result in an unjust and unreasonable rule.

The National Industrial Traffic League protest said members of that organization were vitally interested in the establishment of a just, reasonable and lawful rule, but urged that such a rule should not be established without approval of the commission and after full hearings had been held.

The league said it could not propose a substitute rule which it would regard as just and reasonable, because its members were not in agreement as to what such a rule would be. Consequently, the league said, the commission should hold hearings and determine the issue itself.

Workmen Reclaim Dredge Sunk by Lightning Bolt

Workmen and a professional diver have completed the raising of the steel dredge of the Kickapoo Sand & Gravel Co. which sank in 40 ft. of water in the Wabash River at Peru, Ind., several weeks ago.

The dredge was valued at $25,000 and about $10,000 is to be spent in repairing it. The boat sank when it was struck by lightning during a storm, according to residents on the river bank. No one was aboard when it went to the bottom.

Editorials

No Relief in the Cement Tariff

THE United States Tariff Commission has recommended that there be no change in the present tariff provisions covering cement and cement clinker, holding that the present rate of 6 cents a hundred pounds "substantially equalizes" the difference between the average costs of American- and foreign-made products. The commission has found that the average cost of production of such American-made cement as comes into competition with imported cement is 32.2 cents a hundred pounds, or $1.21 a barrel, and that the corresponding costs of Belgian cement are 18 cents and 67 cents, respectively. The addition of transportation charges brings the cost of American-made cement to 42.2 cents a hundred pounds, or $1.58 a barrel, and that of Belgian-made cement to 36.2 cents a hundred pounds, or $1.36 a barrel. The difference of 6 cents a hundred pounds was held to be covered by the present tariff of that amount.

The recent sale of 40,000 barrels of British-made cement in New York at $1.54 a barrel and other sales of imported cement at even lower prices have indicated the necessity for American producers establishing what has been called a "depressed price" in an attempt to meet the competition. In Boston, where this practice was adopted several years ago, the competition of Belgian-made cement is much less severe than it was and may ultimately be completely controlled.

It should be plain to American producers that the tariff will not control the situation for, if they themselves are willing to reduce prices to profitless levels in order to meet American competition, they must not be astonished if foreign producers adopt a similar course. And, as long as producers of whatever nationality are willing to sell below cost, it is useless to cry over competition, from whatever quarter it may come. American producers seem to be faced with a sufficiently difficult problem in attempting to meet the competition of price-cutting rivals in America without beginning a price war with foreign producers. And if the latter attempt should prove to be no more successful than the former in stabilizing the industry it will certainly cost more in the end than the value of the gains that are supposed to accrue.

Incidentally, the commission's report throws interesting light on the cement prices commonly quoted in this country and on their relation to production costs. Reports of large orders for cement taken at 57 cents a barrel and, more recently in Chicago, at 60 cents a barrel, show wide spreads between selling prices and the production costs found by the commission. If the commission's figures on production cost are as dependable as these reports of selling prices, then it is evident that many cement manufacturers have been selling at much greater sacrifices than was generally believed. And if they find it no great hardship to underbid American competition to the extent thus indicated, they should find it equally easy to meet foreign competition which, in the case of the British importation referred to, undercut the current American price only 17 cents a barrel. It would seem that the remedy for foreign competition lies in the hands of American producers through the exercise of price adjustments and that this method is likely to prove more flexible and more immediately helpful than any relief that may be provided by tariff revision.

The Railroads Win Again

IN their reply to the Interstate Commerce Commission's proposal, that the freight-rate increases granted in Ex Parte 103 should inure to the benefit of the weaker railroads through a pooling of the gains, the railroads, as was to be expected, voiced strong objection to the pooling feature and offered as an alternative the proposition that the pooled gains should be given to a special agency and passed on to the weaker roads in the form of loans repayable after two years rather than as dividends that might be retained. This counter offer had the effect of nullifying the advantages of the commission's plan and, as a result, the commission has withdrawn it and offers neither approval nor disapproval of the railroads' suggestion.

The railroads' rejection of the plan of pooling and distributing the gains of the freight-rate increases forced the commission to alter its attitude to those increases to the extent that, for the previous surcharges of three dollars a car on sand, gravel, stone and slag and of six dollars a car on phosphate rock, sulphur, rock asphalt and other stone, it has substituted flat increases of six cents and twelve cents a ton, respectively, as suggested by the railroads. Other rate increases, such as that of one cent a hundred pounds on cement, gypsum, lime, and sand-lime brick, were left untouched. The new per-ton charges were obtained by dividing the per-car rates as first proposed by fifty, which was taken as the number of tons of material in the average car-load. This change in the basis of rate calculation completely meets the railroads' objection that, under the per-car increases originally suggested, shippers would demand cars of the greatest capacity.

With respect to the railroads' further contention that the increases should not be treated as an entirety, as provided in the commission's proposal—because subsequent reductions in rates would have been taken from the basic rates rather than from the increases allowed—the railroads won a further victory. Although the commission had suggested this plan in order to provide a penalty for railroads that might be tempted to reduce their rates unjustifiably, the railroads replied that the commission

was empowered to prevent any improper reduction.

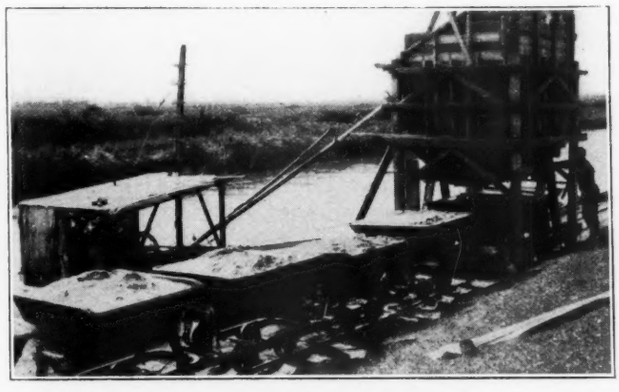
Because of practical difficulties that stand in the way of determining distances and because, too, of the smallness of the increases granted, the commission has decided to authorize a flat increase of two cents in all less-than-carload rates.

Under the circumstances the railroads must be well satisfied with the results, although one must not expect them to agree with the outcome or to acknowledge its sufficiency. While they did not obtain the fifteen-per cent. increase for which they asked, they won a general admission of their right to higher rates, and the increases allowed probably approach, and may even exceed, those which they hoped to get. Their request for a larger increase must not be taken as indicative of their real needs, since in all such matters it is common and wise practice to ask for more than one expects, so that, even after discussion and concession, the net gain is sufficient for the purpose. Also, in political questions where the interest of the public may be held to deserve some consideration, this procedure is particularly subtle, as the government agency from which relief is sought can make a show of guarding the public interest by scaling down the favors requested while leaving enough to satisfy the petitioners.

We must not be astonished, however, if the railroads continue to complain of the hardships under which they operate or of the inadequacy, from their point of view, of the increases granted. Motor buses, motor trucks, and waterways still afflict the railroads as a chronic commercial nettlerash, so agitation against these more modern or more economical forms of transport will be prosecuted with renewed vigor. The policy of "charging all the traffic will bear"—a polite form of expressing the idea of charging all the shipper can be forced to pay—now that it has been sustained by the decision of the Interstate Commerce Commission, will obtain still further support, through discriminatory and confiscatory highway and waterway legislation, if the railroads have their way. Even though it is much more difficult to deal with scores of state legislatures and public-utility commissions than with a single federal body, the railroads are skillful lobbyists and can point to many victories, not the least of which is the final decision in Ex Parte 103.

Australian Sand Producer Hampered by High Freight Rates

The Plowright Albion Koo-Wee-Rup Washed Sand & Gravel Co. Pty. Ltd. operates a sand plant near the town of Koo-Wee-Rup, which is about 42 mi. from Melbourne, Australia. The sand is pumped from the bed of a canal which was excavated years ago to drain this heretofore uninhabitable area of land, according to W. Plowright, managing director



View showing canal, pump-line leading to hopper and loaded cars on track.

of the company. About 50,000 tons of sand has been pumped and disposed of yearly since the company began operating in 1925. Four-inch pumps raise the material from the canal bed and discharge into side-dump cars of 1-cu. yd. capacity through a movable hopper. The material is hauled by a locomotive tractor to an elevated platform, where it is loaded to railway cars.

Most of the sand, according to Mr. Plowright, is used for construction and road-building purposes in Melbourne and vicinity. The company's greatest problem, however, has been one of excessive freight rates, the present rate for hauling the sand the 42-mi. distance being 5 shillings 10 pence per ton, or about $1.40 based on the standard value of the pound sterling.

The company pays the State Rivers and Water Supply Commission a royalty of 3 pence per ton on sand removed from the canal.

New and Revised Specifications Are Approved by A. S. T. M.

A. S. T. M. Committee E-10 on Standards at its recent meeting approved 13 new tentative specifications and methods of test and the revision of 4 existing tentative standards. The titles and designations of those of interest to mineral producers follow:

Submitted by Committee C-9 on Concrete and Concrete Aggregates

- Methods of Test for Soundness of Fine Aggregates by Means of Sodium Sulphate (C 88-31-T)
- Methods of Test for Soundness of Coarse Aggregates by Means of Sodium Sulphate (C 89-31 T)

Submitted by Committee D-18 on Natural Building Stones

- Methods of Shear Testing of Natural Building Stone (D 338-31 T)
- Method for Determining the Elasticity of Natural Building Stone (D 339-31 T)
- Definitions of Terms Relating to Building Stone (D 340-31 T)
- Method of Flexure Testing of Natural Building Stone (D 327-31 T)
- Method of Test for Absorption and Apparent Specific Gravity of Natural Building Stone (D 328-31 T)

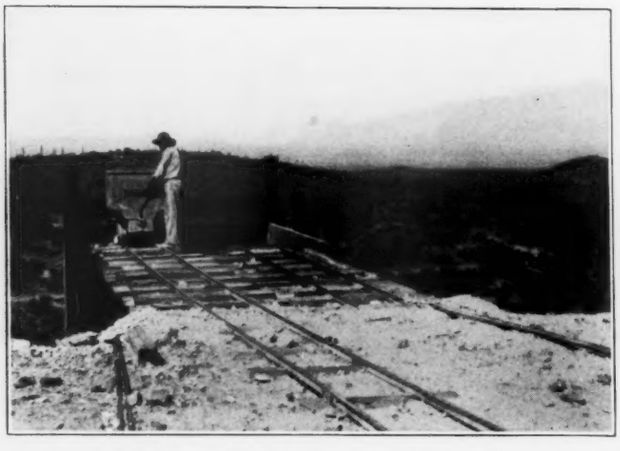
New Arizona Lime Plant Arises 'Mid Sagebrush and Giant Cactus

New Process Lime Co. plant near Tucson, Ariz.

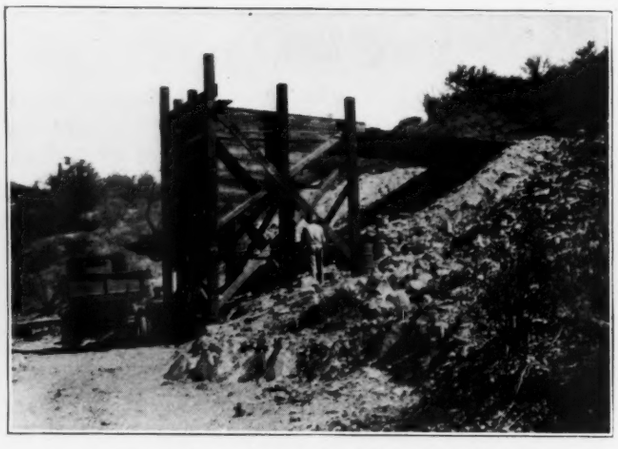
ONE of the most recent developments in the lime industry was the construction of a new lime plant near Tucson, Ariz., by the New Process Lime Co. of that city. This plant went into operation late in July, 1931. While only a one-kiln plant, it has ample capacity to serve its territory and is designed so that it can easily be enlarged at any time. At present it has a daily capacity of 15 tons of lime.

The plant is of concrete and steel construction and is designed for the utmost simplicity of operation without sacrificing quality of product. The entire unit consists of a vertical kiln, hoist-house, ware-house, and office. Each of these buildings is of adobe, stuccoed white, and the entire unit presents a very pleasing appearance. The plant is located on St. Mary's road at the old El Paso and Southwestern Ry. tracks on the outskirts of Tucson.

The quarry from which most of the plant's supply of stone is obtained is located about 7 mi. west of Tucson. The property of 140 acres owned by the company has a limestone deposit averaging from 96 to 98 per cent. pure lime. Tests to a depth of 150 ft. have shown no variation in quality.



Dumping car of stone into truck-loading bin.



Truck being loaded from the stone bin.

A view of the quarry shortly after it was opened, with compressor house at right. Note the giant cactus native in that section.

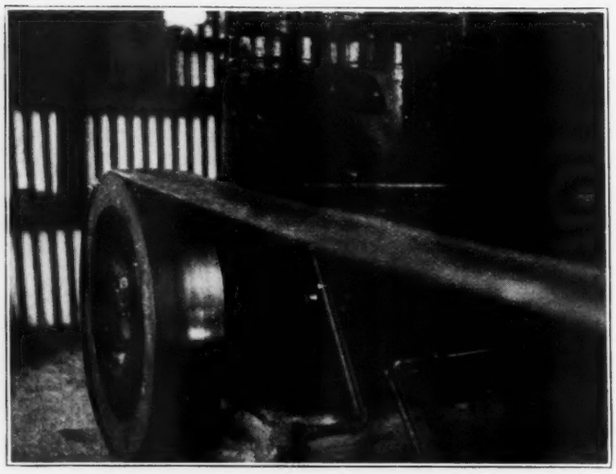
The overburden of 3 to 4 ft. of *caliche* is removed by hand and loaded into a small dump car which removes the material to a waste dump. As the quarry is being worked into the side of a hill the overburden decreases in depth. After a few more months of operation the quarry will reach its ultimate depth and will arrive at a point where the overburden is negligible.

A crew of 3 men operates this quarry. Drilling is done with Cochise jack-hammers using drill steel up to 25 ft. in length. Apache 40-per cent. dynamite is used for blasting. The rock is loaded by hand into a 1-ton capacity steel car with bottom discharge. This car is pushed by hand and is run over a narrow-gage track on a trestle, from which it discharges into a 20-ton timber bin. This discharges through a side chute into a Mack 2½-ton truck which hauls the stone to the plant. A Curtis 2-cylinder vertical air-compressor furnishes air for the drills. The compressor is driven by a 15-hp. Fairbanks-Morse single-cylinder gasoline engine. These units are housed near the quarry in a shed which is covered with American Sheet & Tinplate Co. corrugated-metal siding.

The company also has another quarry at Sahauita, 18 mi. south of Tucson. The material in this de-

Workmen loading rock to car at the quarry.

The skip and screen beneath the kiln.



The air-compressor used at the quarry.

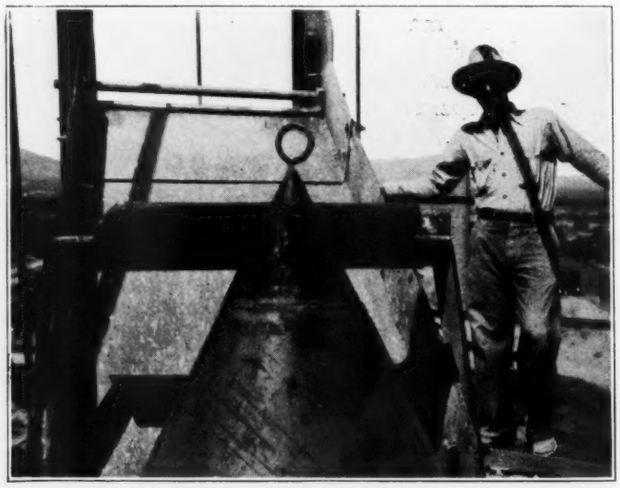
posit has a slightly higher magnesia content and is used only when an order for this type of lime is received.

At the plant the stone is discharged on a storage pile, whereas it is loaded by hand as needed into an automatic skip-dump with a ¾-cu.yd. bucket. This is operated by a 1-drum hoist driven by a 7½-hp. Westinghouse motor. The bucket will hold 1,800 lb. of stone or 600 lb. of coal. The coal is a good grade of anthracite which is shipped in from a mine near Albuquerque, N. M.

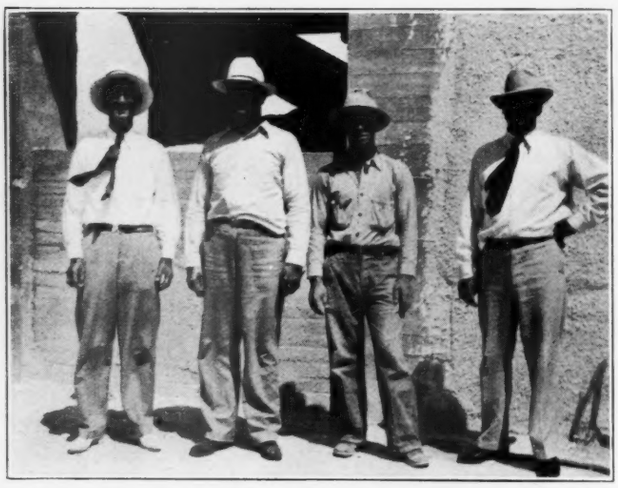
The kiln is charged about 5 times per day on the average, using a 6½-to-1 fuel ratio. The skip-bucket discharges into the top of the kiln through a vent which is covered with a conical steel cap to regulate the draft according to the capacity desired. When running at full capacity this cap is taken off.

The kiln shell is 40 ft. high and has a 12-ft. outside diameter. It is mounted 12 ft. above the ground on a concrete foundation, and is a regular type of vertical shaft kiln. It has a draft chamber of original design, which is said to give increased capacity. The inside diameter is 3 ft. at the top and 10 ft. at the hot zone. General Refractories Co. brick lining is used where the heat is not intense and Acme brand is used for the hot zone.

Lime is drawn from the kiln from 5 to 7 times per day, taking more than 2 tons of lime at each draw. The lime is drawn in the usual manner by pull bars and is fed to a 4-ft. by 8-ft. inclined stationary wire screen with ½-in. cloth. The coarse material is discharged from the screen into the loading building alongside the kiln where it is



Nick Guadagnoli at the top of the kiln beside skip discharge and conical cover.



Left to right: A. J. Menard, Gabe Rendon, Nick Guadagnoli, and Frank Rendon.

broken up and freed from core. This lime, together with the "fines" passing through the screen, is then loaded into box-cars for shipment. Most of the product is used for flotation and building work and is shipped over the Southern Pacific Ry. which has a siding running into the plant. Later a hydrator and putty boxes for the convenience of local contractors may be installed.

The head of this new enterprise is Frank R. Rendan with whom are associated Angelo Guadagnoli and Gabe Rendon. The company also runs at Globe, Ariz., a similar plant which went into operation in April, 1929. This plant furnishes lime for the Old Dominion Mining Co.'s operations in that vicinity.

The Tucson plant was designed by Angelo Gua-

(*Continued on page 54*)

A Modification of the Glycerol Method for Determining Free Lime*

By G. E. BESSEY

IN the course of investigations on the determination of uncombined lime in cements and other building materials a modification of the glycerol extraction method originally suggested by Maynard (1), which appears to have definite advantages over previous forms, has been worked out. Modifications of the original method have been proposed successively by Emley (2), Lerch and Bogue (3), and Rathke (4).

All the methods make use of the fact that glycerol forms with calcium oxide a glycerolate (glyceroxide) which is soluble in both glycerol itself and in mixtures of glycerol and alcohol. Calcium oxide and calcium hydroxide both dissolve very slowly in glycerol, dissolution being slower with the hydroxide, but quantities of either not exceeding 0.05 g. can be dissolved in 20-30 c.c. of glycerol in a few hours if maintained at 60-80 deg. and occasionally shaken.

The compound is partly hydrolyzed by water. Maynard's method was to heat 0.5 g. of the sample with 50 c.c. of glycerol at about 40 deg. for several days with occasional shaking. An aliquot portion of the solution was then filtered directly or diluted with alcohol and filtered, and the calcium oxide determined in the filtrate.

In the method devised by Emley for sand-lime bricks, and applied by Lerch and Bogue to cements, the sample is boiled with an alcohol-glycerol mixture and titrated while hot with an alcoholic solution of ammonium acetate, using phenolphthalein as indicator. The operations of boiling and titrating are repeated until the pink color does not reappear on boiling for several minutes.

The ammonium-acetate solution is standardized by titration of pure freshly-ignited lime in the same way. The final form of the method, as described by Lerch and Bogue, has been found by other workers to give good results with unhydrated Portland cements, and has been largely adopted for testing for free lime for routine and research purposes.

Though fairly satisfactory for such materials, it suffers from certain minor disadvantages. It is not easy to obtain a sharp end-point in the presence of colored material, and the excess, if any, of the added reagent during the titration may react with the cement. The necessity of boiling off the ammonia formed during the titration also tends to complicate the end-point. The method is not difficult to carry out, but is somewhat tedious, and occupies a considerable amount of time if the free-lime content of the sample is high.

In the modification recently described by Rathke the lime is completely dissolved by heating the sample gently with anhydrous glycerol in a closed vessel for some hours before titrating. An alcoholic solution of tartaric acid is substituted for that of ammonium acetate for titration.

Tests on cements and sand-lime bricks have been carried out using both Lerch and Bogue's and Rathke's methods. The only modification found desirable in Lerch and Bogue's procedure was the substitution of 30 min. for 10 min. boiling before the final titration to complete the dissolution of the last traces of free lime. Duplicate determinations on a number of cements and sand-lime bricks which are shown in the table, columns 2 and 3, are seen to yield consistent results.

The modification suggested by Rathke was examined more completely, since it appeared to offer certain advantages over the previous methods. It was found, however, to suffer from other disadvantages which rendered it unsatisfactory. The end-point was very difficult to observe accurately, as the tartaric acid formed a gelatinous precipitate on reaction with the lime, and this precipitate tended to absorb the phenolphthalein slightly.

Moreover the standardization of an accurate 0.1*N* solution of tartaric acid by pure calcium oxide showed a very abnormal value, probably due to the formation of a complex of calcium with the hydroxyl groups in the tartaric acid molecule. Duplicate determinations on a number of samples are shown in the table, columns 4 and 5. The mean results do not agree well with those by the ammonium acetate method, and the individual results do not agree amongst themselves.

Modified Method.—A modification of this method has, however, been worked out at the Building Research Station and yields satisfactory results. The end-point of the titration was somewhat improved by using the phenolphthalein indicator externally on a white porcelain tile, but is still not sharp. The other change made was the substitution of benzoic acid for tartaric acid, the calcium salt of the former acid being freely soluble in the alcohol-glycerol mixture. Although benzoic acid is definitely monobasic, an empirical standardization of the standard solution is still required, and is carried out by titration of pure calcium oxide after dissolution in glycerol, as described later.

The theoretical equivalence for 0.1*N* acid is 1 c.c. = 0.0028 g. CaO. Actually it is normally found in the standardization by calcium oxide to be of the order 0.0030-0.0035 g. CaO. Two reasons may be suggested for this. The compound formed by the glycerol and lime is partly hydrolyzed in solution and, hence, will be in equilibrium with its hydrolysis products, glycerol and calcium hydroxide. When the calcium hydroxide has been removed by the benzoic acid down to the p_H of color change of phenolphthalein, the equilibrium may be such that hydrolysis is incomplete, and hence the whole of the lime is not titrated.

* Reprinted from the *Journal of the Society of Chemical Industry* (England).

This is probably the less important of the reasons for the abnormal standardization, the other and more important being the formation of a small proportion of a more stable compound or compounds with acidic materials developed in the glycerol during heating. It has been found that previous heating of the glycerol in an open dish causes a considerable increase in the abnormality of the results, and considerable discoloration of the solution is observed after heating with the lime; it is probable that the oxidation which takes place in this case does so to a smaller extent in the actual determination, thus causing the abnormal equivalence.

It does not appear possible to say whether this effect is completely allowed for by the empirical standardization, and it is possible that a small error is involved. Since, however, the value obtained in standardization is independent of the weight of lime taken, the effect of the above would appear to be nearly proportional to the amount of lime present, and hence the error due to this is likely to be small.

Procedure.—The procedure with the modified method is as follows: A standard 0.1*N* solution of benzoic acid in anhydrous ethyl or methylated alcohol is prepared. This is stored in a vessel closed to the air and attached to an automatic burette which is protected by a guard-tube containing phosphorous pentoxide. The burette should have a glass bead valve or pinch-cock in place of a glass tap, since the latter can not be satisfactorily lubricated with an alcoholic solution.

Glycerol is required which shall be of not less than 99.2 per cent. purity and free from any acidity. A commercial product of this purity is available. The ordinary "A.R." product containing some 2 per cent. of water is not satisfactory, as appreciable hydrolysis of compounds of lime in the sample may take place. The difference between results when using the 99.2 per cent. pure and 100.0 per cent. pure glycerol, prepared by distillation *in vacuo*, was found to be inappreciable. The glycerol is stored in a vessel attached to an automatic pipette and is protected by a phosphorus pentoxide guard tube.

The solution of benzoic acid is standardized by pure calcium oxide, preferably prepared from pure calcium carbonate ignited at 1,000 deg. to constant weight. The "A.R." grade of precipitated carbonate gives the finest-grained and most reactive product. For standardization 0.02 to 0.5 g. of the pure, freshly-ignited lime is added to 20 c.c. of the glycerol in a 100-c.c. conical flask, and the latter tightly stoppered by a glass or rubber stopper and well shaken. It is important to add the lime to the glycerol and not *vice versa*, as otherwise there is a tendency for the lime to cake on the bottom and make dissolution difficult.

The flask is placed on a hot-plate or in an oven at 60 to 80 deg. for 24 hr. and shaken at intervals; at the end of this period all the lime should have completely dissolved. Then 20-30 c.c. of the alcohol is added, the mixture is shaken and titrated with the benzoic acid, using phenolphthalein as indicator. The titration may be carried out using the indicator internally or externally, as the result is practically the same in the clear solution. The end-point is not sharp, but may be read to within 0.2 c.c. of 0.1*N* acid.

For actual determinations sufficient sample to give not more than 0.05 g. of free lime (*i.e.*, 1 g. where the free lime content is less than 5 per cent.) is weighed and added to 20 c.c. of glycerol, and treated as in the standardization. The indicator should be used externally, and the end-point taken when no pink color develops on addition of a drop of the titrated solution to a drop of the phenolphthalein solution on a tile.

The sample normally must remain in contact with glycerol for 24 hr. at 60-80 deg. but, where the free-lime content is very low, 5-6 hr. is sufficient.

Sources of Error.—The modified glycerol method described above has been applied with fairly satisfactory results to sand-lime bricks and to unhydrated cements, but has certain possible sources of error, the importance and magnitude of which are at present not certain. Comparative results with

(*Continued on page 26*)

FREE LIME IN CEMENTS AND SAND-LIME BRICKS BY GLYCEROL EXTRACTION METHODS (CaO%)

Sample	Ammonium Acetate		Tartaric Acid (Rathke)		Benzoic Acid	
	Actual	Mean	Actual	Mean	Actual	Mean
1. Portland cement A	2.94 2.90	2.9	4.89 5.62	5.3	3.13 3.20	3.2
2. Portland cement B	1.51 1.67	1.6	.....	.....	2.01 2.14	2.1
3. Rapid-hardening Portland cement A	2.81 2.94	2.9	2.64 2.92	2.8	2.61 2.64	2.6
4. Rapid-hardening Portland cement B	0.94 1.16	1.1	3.07 2.90	3.0	1.77 1.38	1.6
5. Portland-cement clinker	0.75 1.04	0.9	.....	.....	1.76 1.78	1.8
6. Portland blast-furnace cement A	0.13 0.13	0.1	0.4 0.4	0.4	.....	.....
7. Portland blast-furnace cement B	1.74 2.24	2.0	2.36 2.50	2.4	1.45 1.70	1.6
8. Cold-process slag cement	9.61 9.71	9.7	.....	.....	9.30 9.25	9.3
9. Aluminous cement (fondu)	Nil	Nil	Nil	Nil	Nil	Nil
10. Aluminous cement (English)	Nil	Nil	Nil	Nil	Nil	Nil
11. Set Portland cement	11.5 12.1	11.8	.....	.....	13.2 13.6	13.4
12. Set aluminous cement	0.05	Trace	.....	.....	0.07	Trace
13. Sand-lime brick A (laboratory-prepared)	Nil	Nil	Nil	Nil	Nil	Nil
14. Sand-lime brick B (laboratory-prepared)	6.1	6.1	.....	.....	5.3	5.3
15. Sand-lime brick, commercial sample A	Nil	Nil	.....	.....	Nil Trace	Trace
16. Sand-lime brick, commercial sample B	Nil	Nil	.....	.....	0.15 Nil	Trace
17. Sand-lime brick, commercial sample C	0.57	0.6	.....	.....	0.52 0.66	0.6
18. Sand-lime brick, commercial sample D	1.48	1.5	.....	.....	1.31 1.52	1.4

Tariff on Cement to Remain Unchanged; Pleas of Producers Ignored

APPROVAL by President Hoover of the report of the United States Tariff Commission, recommending that the present tariff duty on cement and cement clinker be not disturbed, means there will be no change in the rates at present, despite the pleas of domestic producers.

In its report of an investigation into comparative domestic and foreign costs, undertaken as a result of a senate resolution adopted June 20, 1930, the commission found the present rate of 6c per 100 lb. on Roman, Portland and other hydraulic cement and cement clinker (including the weight of the container) "substantially equalizes" the difference between the average cost of the domestic and foreign article.

Commissioner Thomas Walker Page, in a dissenting opinion, declared the present duty of 6c per 100 lb. was "rather prohibitory than 'protective' in the sense contemplated by the law." He declared that cement should be restored to the free list.

In its investigation the commission used the year 1929, which it said was a representative year.

The commission pointed out that, because of the high cost of rail transportation of cement as compared with the cost of manufacture, and because cement is consumed throughout the country, the position of the several cement-producing districts with respect to competition of imported cement differs widely. For the purpose of cost comparison between the domestic and foreign product, the commission said, only the costs of those domestic producing districts which are near the coasts have significance.

The commission found the cost of production of Portland cement at those plants in the United States which supply the principal markets, averaged by weighting according to the actual amount of their respective shipments to the principal markets, was 31.6c per 100 lb. for the period under investigation. The corresponding cost of production of those plants in Belgium which actually shipped to the principal markets, averaged on the basis of weighting according to their respective shipments to the United States, was 16c per 100 lb.

The principal markets in the United States used by the commission in its investigation were Boston, Providence, New York, Philadelphia, certain points in North Carolina of which Charlotte is representative; certain points in South Carolina of which Charleston and Columbia are representative, Tampa (Fla.), New Orleans (La.), Houston (Tex.), certain points in Texas of which Corpus Christi, San Antonio and Mission are representative, Los Angeles (Calif.), Portland (Ore.), and Seattle (Wash.).

Other important conclusions of the commission were:

The cost of production of those domestic plants situated in districts which shipped to the said principal markets, when the cost of production is computed by districts, the cost for each district being averaged on the basis of weighting according to the total production of the several plants, was 31.6 cents per hundred pounds for the period covered by the investigation. The corresponding cost of production of all plants in the principal competing country for which costs were obtained, whether or not they actually shipped to the United States, similarly averaged, was 18 cents per hundred pounds.

The cost of production of Portland cement at plants for the 6 coastal cement-producing areas, weighted by production of individual plants irrespective of district, was 32.2 cents per hundred pounds. The corresponding cost for the similar product imported from Belgium was 18 cents per hundred pounds.

The cost of transportation and other delivery charges on cement to the said principal markets from those domestic plants which actually shipped to said markets, averaged by weighting according to their respective shipments, was 10 cents per hundred pounds, and the corresponding cost from the plants in the principal competing country to the same markets, similarly averaged, and including certain such charges incurred by the importers, was 18.5 cents per hundred pounds. The cost of transportation and other delivery charges from the centers of production in the principal competing country, the internal freight charges in Belgium being averaged by weighting according to the production of each plant for which costs of production were obtained, whether or not they actually shipped to the United States, was 18.2 cents per hundred pounds.

The total cost of production of cement, including transportation and other delivery charges to the principal markets in the United States, of the domestic plants which shipped to such principal markets, was thus 41.7 cents per hundred pounds when both cost of production and transportation charges are averaged by weighting according to the actual shipments of each plant to said markets; and 41.6 cents per hundred pounds when the cost of production is computed by districts, the cost of production for each district being averaged on the basis of weighting according to the total production of the several plants and the cost of transportation being averaged on the basis of weighting by actual shipments from each plant to said markets. The corresponding cost of the foreign cement was 34.5 cents per hundred pounds when costs of production are averaged by weighting according to the shipments of each plant to the principal markets in the United States; and 36.2 cents per hundred pounds when these costs and costs of internal freight in Belgium are averaged by weighting according to the production of the several plants for which costs were obtained, whether or not they actually shipped to the United States.

The total cost of production of cement for the 6 coastal areas, weighted by production of individual plants, irrespective of districts, including transportation and other delivery charges to the principal markets in the United States weighted on the basis of actual shipments to said principal markets, was thus 42.2 cents per hundred pounds. The cost of production for the Belgian cement, calculated on the same basis, and the internal freight charges in Belgium being averaged by weighting according to the production of each plant for which costs of production were obtained, whether or not it shipped to the United States, and the remaining transportation charges weighted on the basis of actual shipments of the respective plants to the principal markets in the United States, was thus 36.2 cents per hundred pounds.

The excess of the domestic over the foreign costs, including transportation and delivery to the said principal markets in the United States, on the first basis above mentioned was 7.2 cents per hundred pounds, on the second basis was 5.4 cents per hundred pounds, and on the third basis was 6 cents per hundred pounds, which is equal to the present duty.

On account of the importance of transportation charges the total cost of domestic cement, including transportation and delivery, differs materially at the several individual principal markets. The same is true of the cost of the foreign product.

The excess of the domestic costs of production over the Belgian costs, including transportation and delivery, based upon costs of production and transportation weighted on the basis of actual shipments, ranged from 2.3 cents per hundred pounds at Houston, Tex., to 26.6 cents per hundred pounds at Charleston, S. C. At Los Angeles, Cal., the Belgian cost of production, including transportation and delivery, weighted upon the same basis, exceeded the corresponding domestic cost by 4.8 cents per hundred pounds.

Cement clinker is that stage of the product which precedes the final grinding into finished cement. From 70 to 85 per cent. of the total factory cost of finished cement, exclusive of the containers, is represented by the costs of bringing the product to the clinker stage. Cement clinker is not ordinarily an article of commerce, being usually ground and finished at the same plant by which it is made. There was, however, during 1929 and 1930, some importation of cement clinker into Los Angeles, where it was ground for final use.

The commission obtained the cost of production of cement clinker during 1929 at a domestic plant in California which manufactured clinker for sale as such, together with the cost of transportation thereof to Los Angeles. The commission also obtained the cost of production of cement clinker at a Belgian plant which shipped clinker to Los Angeles in 1929, together with the cost of transportation and delivery to that city. These costs can not be disclosed without revealing the operations of individual concerns. The excess of the domestic over the foreign costs were substantially equal to the present duty.

No other relevant factors constituting an advantage or a disadvantage in competition were disclosed in the course of this investigation.

Rise in Imports of British Cement Disturbs Eastern Market

The landing of two shiploads of British portland cement, aggregating 40,000 barrels, in New York last month has aggravated the price situation in the east. This foreign product is understood to have been sold at around $1.35 a barrel, packed in paper containers, as compared with the current domestic quotation of $1.54 a barrel. It is the belief of American manufacturers that if importations continue it will be necessary for them to establish a "depressed price" in this market to meet the competition. Such a price has been in effect in Boston for several years where it has successfully competed with Belgian importations which at one time threatened to eliminate the American product from the district.

The sharp rise in imports from Britain reflects lower production costs in England due to the abandonment of the gold standard. American producers estimate that the depreciation in sterling exchange recently has lowered British costs by as much as 25 per cent.

Modification of Glycerol Method

(*Continued from page 24*)

the ammonium acetate modification are shown in the table. It is seen that consistent results are obtainable, and that agreement between the methods is usually good, although occasionally appreciable differences are obtained in the case of cements. There is, however, no readily available means of checking the absolute accuracy of either method.

White's qualitative microscopic test (5) shows good agreement when only very small quantities are present, but can not be used to determine appreciable amounts. The ammonium acetate-glycerol method has been tested on the individual compounds occurring in cement by Emley and by Lerch and Bogue; further, both methods have been shown not to give high results with sand-lime bricks during the present investigation, since a zero result is obtained with samples having no free lime present.

These methods are not applicable to hydrated materials other than sand-lime bricks, as calcium hydroxide is only slowly dissolved by the glycerol, and, in the case of hydrated cements, the small amounts of water formed during the reaction cause uncertain errors in the result. Other methods have been devised for such materials, and are described elsewhere (6).

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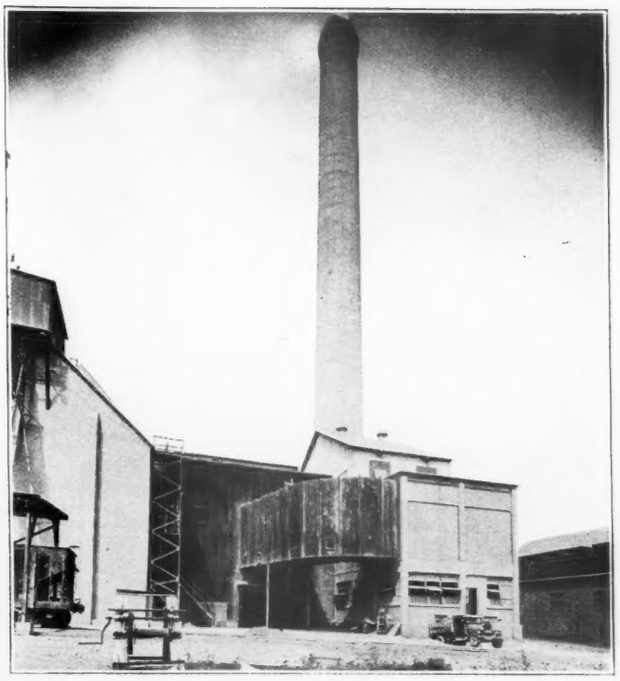
General view of the precipitator installation.



Another view showing flue connection and stack.

Precipitators Collect Over 90 Tons of Dust Daily in This Cement Mill

Recent Installation at North American's Plant at Security 95 Per Cent. Efficient

By P. E. LANDOLT

DURING 1927, when waste-heat boilers and a stack were added to the plant equipment of the North American Cement Corp. at Security, Md., provision was made for the later installation of a Cottrell dust collector for recovering the dust from the kiln gases. It was decided late in 1930 to complete the installation. Originally only the shell structure designed for Cottrell equipment was installed. It was necessary to add a superstructure and to install the various operating parts, which necessitated a plant shut-down of a few weeks at the period of the annual winter closing, so no productive time was lost.

The Security plant has a maximum productive capacity of 5,000 bbl. of Portland-cement clinker per day. There are five kilns 10 ft. by 8 ft. by 125 ft., which operate on the dry process. A good grade of pulverized gas-slack is the fuel used.

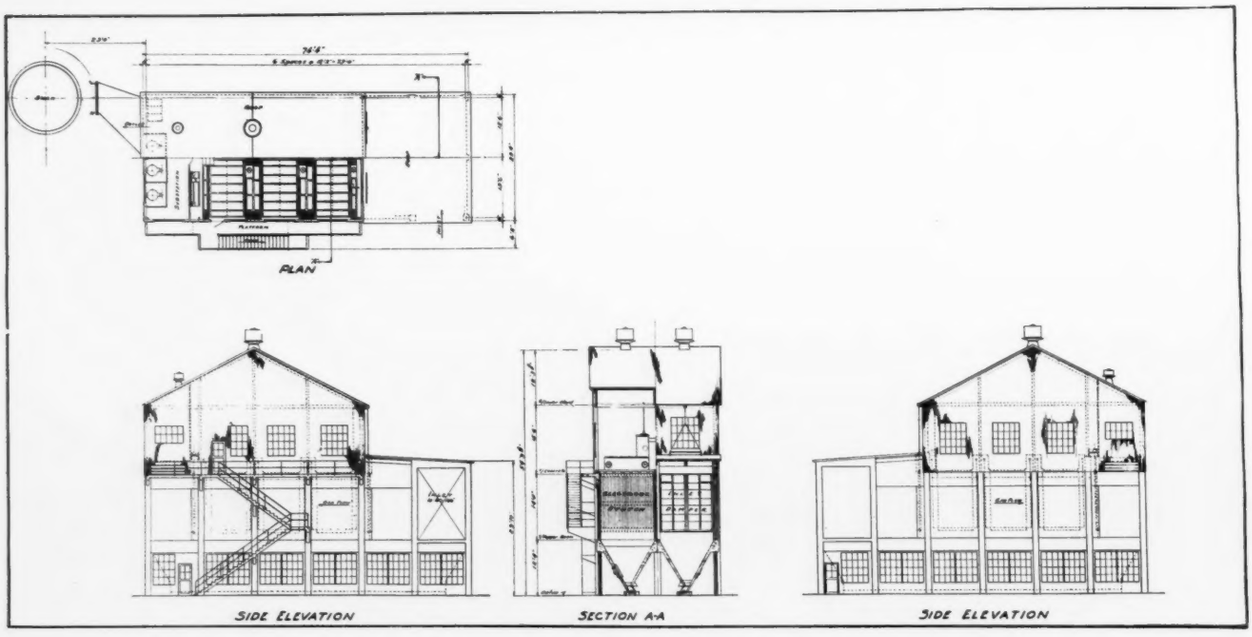
All the power required to operate the plant is obtained from modern waste-heat boilers and turbo-generator installations. There is sufficient heat in the kiln exit gases to generate steam for all purposes. These hot gases were formerly discharged into the atmosphere and were not utilized in any way. In this respect, the cement industry during the past fifteen years has introduced in many plonts one of its greatest economies.

The raw materials at Security are principally limestone and shale, with a small percentage of cinders, thereby making a three-component mix. These materials are thoroughly blended and ground to extreme fineness before entering the kilns.

In the operation of the Security kilns considerable dust formerly escaped with the combustion gases to the outside atmosphere. The company decided in the autumn of 1930 to install a Cottrell precipitator in the structure already provided. This equipment was completed and placed in operation late in March, 1931, and since that time has collected 95 per cent. of the dust in the kiln gases and is functioning satisfactorily.

In addition to the successful cleaning of the kiln gases, flue connections have been made from the raw-material driers, elevators, conveyors, and raw-grinding mills, which were former sources of dust within the plant building to the Cottrell precipitator, thereby rendering the air in these departments clean and free from dust.

Operating at a reduced daily output of 3,500 bbl. of clinker the kiln dust alone collected in the precipitator totals more than 90 tons per 24-hr. day. Every pound of this material is returned with the ground raw mix to the kiln and thereby replaces a like number of tons of rock, which would otherwise have to be quarried, dried, and pulverized. The precipitator, in removing the dust from the discharged gases and returning it to the kiln feed, has not only eliminated an annoying condition to the



Plan and elevations of the electrical-precipitator installation.

plant and immediate surroundings, but the savings effected through the operation of this equipment, after deducting interest and other charges, will pay for the installation in a comparatively few years.

The Cottrell precipitator in the Security plant is of the rod-curtain type designed to treat 200,000 cu. ft. per min. of gases at 300 to 350 deg. F., when producing approximately 4,000 bbl. of clinker per day. There are two units of three sections, each

View showing top of the precipitator units.

with 18 unit ducts per unit containing approximately 16,700 ft. total effective length of electrode.

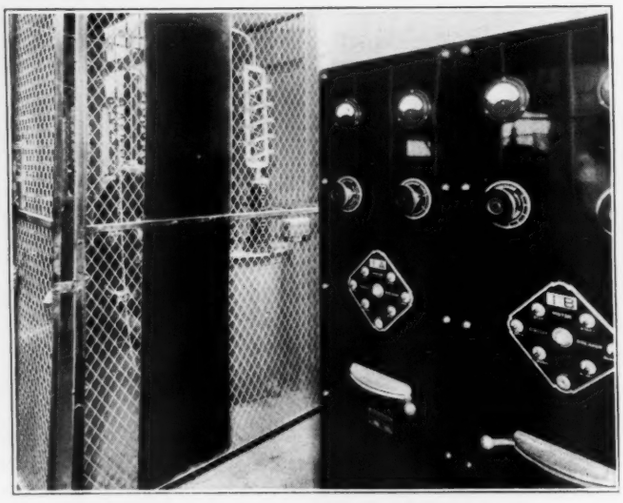
Each unit is provided with inlet and outlet multivane dampers for the control of gas distribution and for shutting down the unit. The inlet dampers are hand-operated, being usually set for a given gas flow and left in a fixed position. The outlet dampers are motor-operated and, with push-button controls, can be operated from a position adjacent to the electrical-control room.

Each section of the precipitator is provided with a rapping system for removing the dust from the high-tension electrodes and the grounded rod-curtains. The high-tension rappers are hand-operated, and the rod-curtains are rapped by means of a special pneumatic hammer applied at designated points on the top of the precipitator.

The electrodes, both high-tension and rod-curtains, are rapped at approximately 2-hr. intervals.

The units are energized by three special electrical units so interconnected with high-tension switches as to provide the greatest flexibility of application of each electrical set to each pair of precipitator sections. These electrical sets are carefully screened for safe operation and are connected to the precipitator sections by means of a special high-tension cable. At each precipitator section there is a high-tension disconnect switch. All high-tension parts are carefully inclosed and provided with safety interlocks to avoid any operating hazard.

The electrical sets are operated at a transformer voltage of approximately 65,000, with a total power consumption of approximately 25 to 30 kw.



Switchboards and electrical-control equipment.

The fine-crushing and screening plant with transformer house at left and new lime-plant storage at right.

New Fine-Crushing and Screening Plant in Ohio Sets High Standard

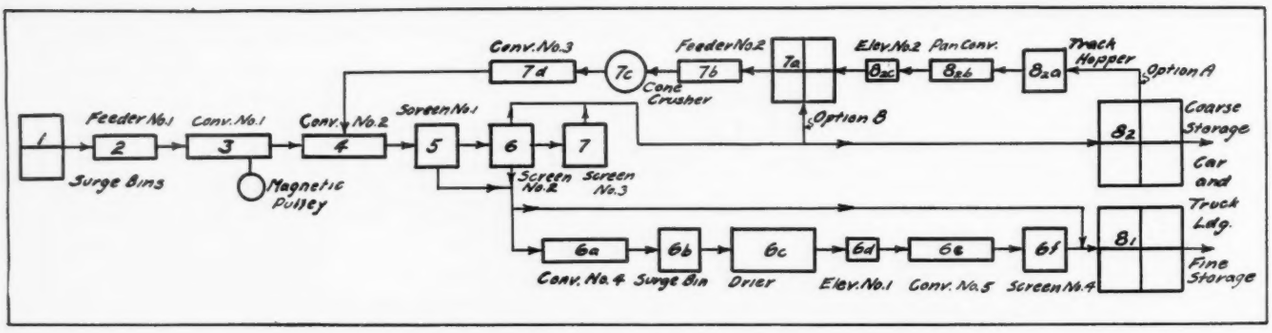
Kelley Island Lime & Transport Co. Has Built Industry's Outstanding Operation

By W. E. TRAUFFER

EACH year an increasing number of plants are built in the nonmetallic-mineral industries of each of which it can be said that it involves the latest features of engineering design both in its construction and equipment, that it is of permanent, fireproof construction, that it provides flexibility and simplicity of operation, and that the man-power required to operate it is reduced to what seems to be the absolute minimum. These are all very important features, but in many of the abovementioned plants other features of almost equal importance are lacking. These generally have to do with the cleanliness of the plant or the comfort and safety of its employees.

Suppose, for example, that one were asked to select half a dozen plants to be inspected by some foreign visitor of prominence in the industry in his own country. This request would naturally call for careful consideration of the plants to be listed, as any one with pride in the industry would want this visitor to leave this country favorably impressed with what he had seen over here. He would not be sent, therefore, to a plant where he would be forced to wear overalls to keep from being covered with dust or grease, or where he would be constantly dodging flying stones or dripping water. Neither would he be sent to a plant where the machinery had been crowded into too cramped a space, necessitating care lest he become entangled in moving machinery or bump his head on projecting beams, nor one untidily kept up with tools, parts, grease buckets, etc., detracting from the appearance of the plant. A plant where careless engineering had made necessary obvious patchwork or unnecessary rehandling of material or one where excessive vibration or noise is present would also be eliminated from consideration. In short the plants selected would be those showing the results of engineering skill which had considered the problem from angles not ordinarily thought important in plant construction.

The new fine-crushing and screening plant of the Kelley Island Lime & Transport Co. at Clay Center, Ohio, is one of those which would be unhesitatingly selected for this list by any one who had seen it in operation. Not only does it qualify in every respect as an efficient, economical plant but it is one in which it would be a pleasure to work. In its design all the usual economic and mechanical features were considered, as well as the many other factors contributing to the safety and health of the employees and to the appearance of the plant. In every detail this plant shows the wisdom of its owners in employing specialized engineering talent familiar with every phase of design, construction and operation and interested solely in building the best possible plant. No fine points of design or construction have been neglected in this plant.



Flow-sheet of the plant operations. Key numbers refer to table below.

The design of the plant is based on a requirement of 140 tons per hr. This is all to be crushed and screened to material passing through ½-in. square openings. The feed to the plant consists of material passing through 2½-in. openings. The capacity is considerably increased when the crushing requirements are not so severe as stated above. The actual capacity has exceeded the expectation, and in a test run the plant has produced 130 tons per hr. through ⅜-in. square mesh.

One of the major considerations in the design of the plant was flexibility. It can produce any 8 sizes between 2-in. and 100-mesh at one time. Special care is taken in the production of small sizes of stone, ⅜-in. or less, and any sizes under 4-mesh are dried before final screening. Provision is also made for the recrushing of any of or all the larger sizes of material, either direct from the screens or by reclaiming from the storage bins. The production of the larger sizes is only incidental to that of the finer sizes.

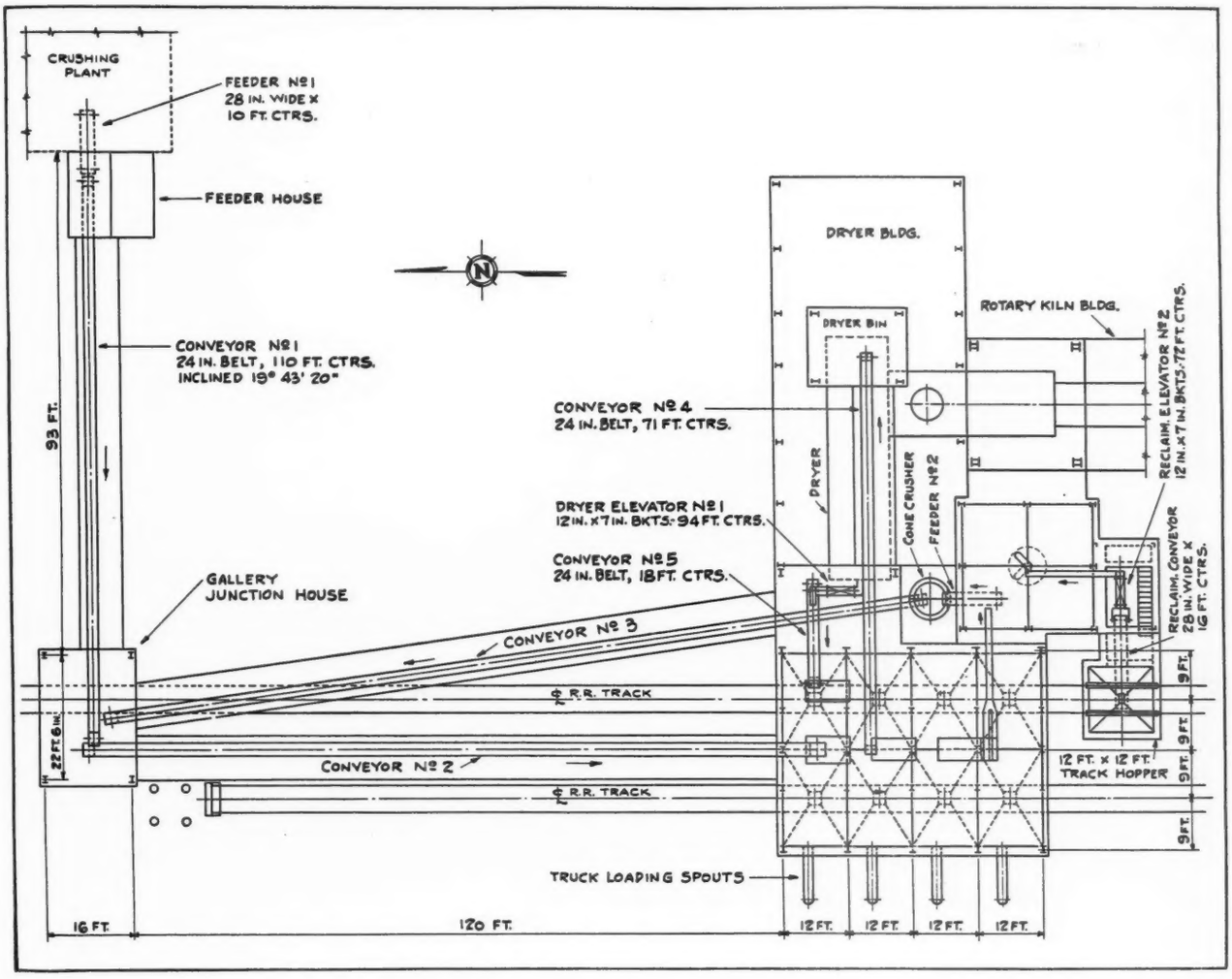
The surge bins in the preliminary crushing plant which furnish the raw material for the "fines" plant are large enough to furnish an uninterrupted supply of material in case of a minor breakdown or during the noon hour when the quarry is shut down. The variable-speed feeders under the surge bin and over the crusher allow accurate feed control for any conditions. These are also used to control the quantity of material with respect to the weather, as wet material must be fed to the screens more slowly than dry.

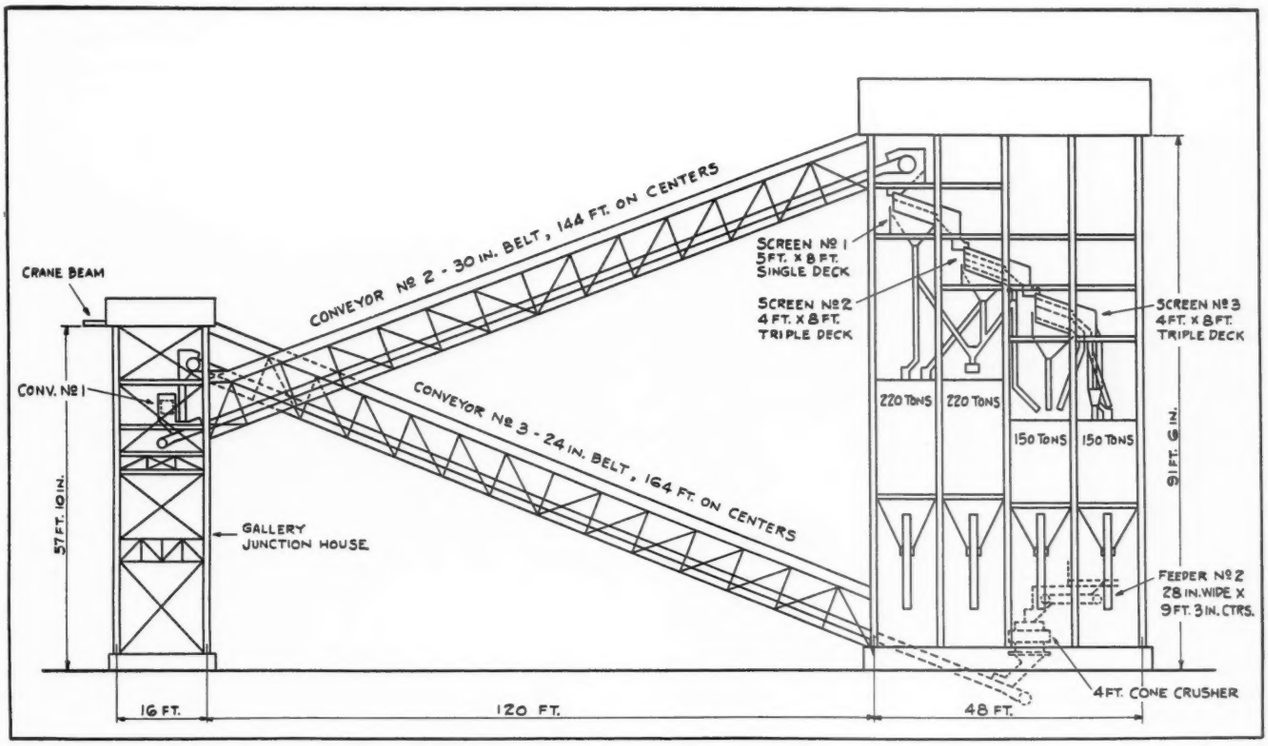
The concrete foundations of the plant rest on bed rock. The steel framework is designed to take any stress which might possibly be placed on it and is amply strong to support any additional load created by machinery installed to increase the capacity of the plant in the future. As a result of the care taken in its design, there is not one point in the entire plant where excessive vibration is created when the plant is in operation. Needless to say this is an unusual feature and was achieved without the use of unnecessarily-heavy structural members. Actually less steel was used than in the average plant of this size and capacity.

Another feature which is strikingly apparent to any one going through this plant is the accessibility of every piece of equipment. Each unit either rests

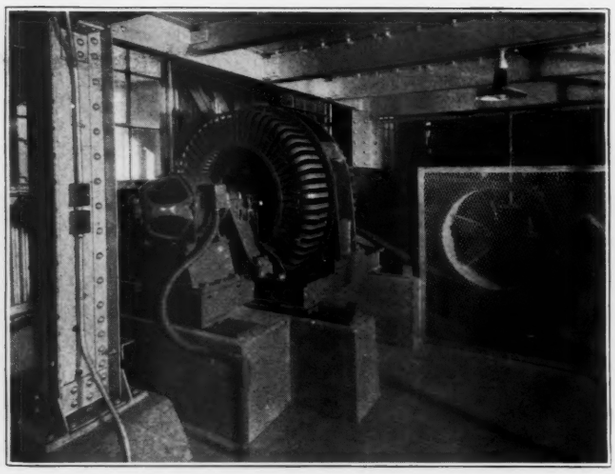
TABULAR ANALYSIS OF THE OPERATIONS AND EQUIPMENT OF THE KELLEY ISLAND LIME & TRANSPORT CO. FINE-SIZING PLANT AT CLAY CENTER, OHIO

Operation	Key	Equipment	Make	Model No., Size, Capacity or Type	Power Source	Power Transmission
Crushed-raw-material storage and handling	1	Surge bins (2)	American Bridge Co.	100-ton		
	2	Feeder No. 1	Stephens-Adamson	28-in. by 10-ft. pan	3-hp. motor	J. F. S. variable-speed and Falk reducers
	3	Conveyor No. 1	Stephens-Adamson	24-in. by 110-ft. belt	7½-hp. motor	Falk speed-reducer
	4	Conveyor No. 2	Stephens-Adamson	30-in. by 144-ft. belt	15-hp. motor	Falk speed-reducer
Screening	5	Screen No. 1	Stephens-Adamson	5-ft. by 8-ft. single-deck	7½-hp. G. E. motor	Dayton Cog-Belt
	6	Screen No. 2	Stephens-Adamson	4-ft. by 8-ft. triple-deck	7½-hp. G. E. motor	Dayton Cog-Belt
	7	Screen No. 3 (to 8_2 or 7a)	Stephens-Adamson	4-ft. by 8-ft. triple-deck	7½-hp. G. E. motor	Dayton Cog-Belt
Drying (fine stone)	6a	Conveyor No. 4	Stephens-Adamson	24-in. by 71-ft. belt	5-hp. motor	Falk speed-reducer
	6b	Surge bin	American Bridge Co.	150-ton parabolic		
	6c	Drier		7-ft. by 40-ft. indirect-heat		
	6d	Elevator No. 1	Stephens-Adamson	12-in.by7-in.by94-ft.rotary	7½-hp. motor	Falk speed-reducer
	6e	Conveyor No. 5	Stephens-Adamson	24-in. by 18-ft. belt	El. No. 1 head shaft	Inclosed chain
	6f	Screen No. 4 (to 8_1)	Stephens-Adamson	4-ft. by 8-ft. triple-deck	7½-hp. G. E. motor	Dayton Cog-Belt
Storage for shipment	8_1	Fine-material bins (4)	American Bridge Co.	220-ton hopper-bottom		
	8_2	Coarse-material bins (4) (optional to 8_2a)	American Bridge Co.	150-ton hopper-bottom		
OPTION A—*Flow for Handling Stored Coarse Stone to Crushing Circuit*						
Reclaiming coarse stone for recrushing		(from 8_2)				
	8_2a	Hopper		12-ft. by 12-ft.		
	8_2b	Pan-conveyor	Stephens-Adamson	28-in. by 16-ft. apron	5-hp. motor	Falk speed-reducer and chain
	8_2c	Elevator No. 2 (to 7a)	Stephens-Adamson	12-in. by 7-in. by 72-ft.	10-hp. motor	Falk speed-reducer
OPTION B—*Flow for Recrushing All Coarse Material*						
Recrushing		(from 7)				
	7a	Collecting bins (4)	American Bridge Co.	100-ton		
	7b	Feeder No. 2	Stephens-Adamson	28-in. by 9-ft. 3-in. pan	3-hp. motor	J. F. S. variable-speed and Falk reducers.
	7c	Crusher	Symons	4-ft. short-head cone	150-hp. Westinghouse Motor	Allis-Chalmers Tex-rope
	7d	Conveyor No. 3 (to 4)	Stephens-Adamson	24-in. by 164-ft. belt	7½-hp. motor	Falk speed-reducer





Plan and cross-sectional elevation of the new Kelly Island Lime & Transport Co. plant.



Close-up view of crusher motor with crusher at right.

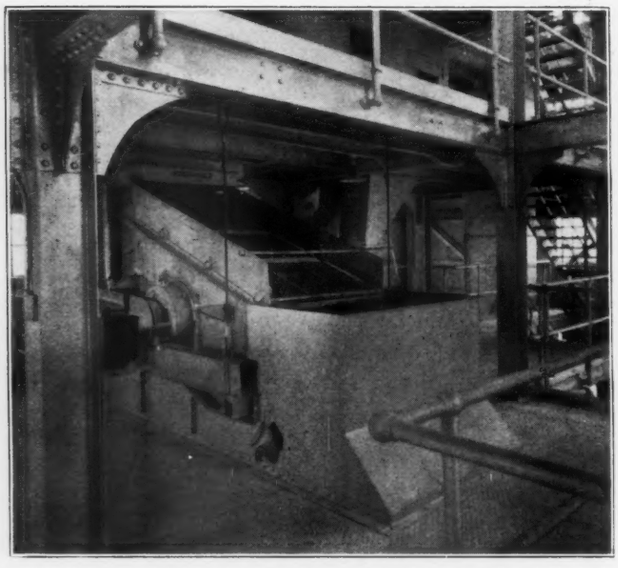
Cone crusher with feeder above and motor in background.

on a floor or has a platform built around it so that not even a step-ladder is required to reach any part of any unit, whether for greasing, adjustments or repairs. Even the elevator drives and the feeders, which are usually in almost inaccessible locations, are easily reached. All passageways, stairs, etc., are wide, and there is not one place in the plant that could be called cramped for space.

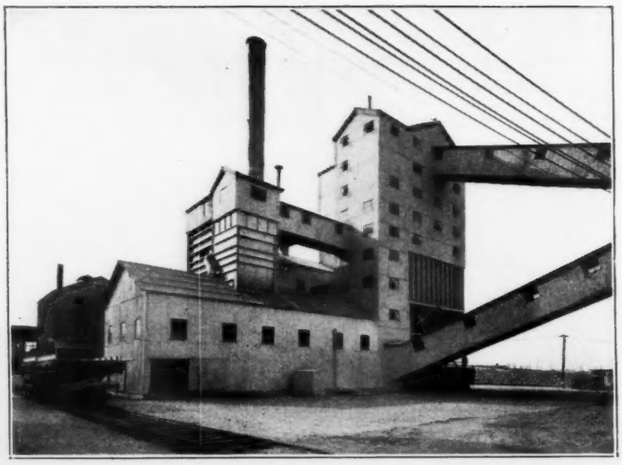
The equipment selected for the plant is the best obtainable. Anti-friction bearings are used throughout, and all machinery is driven through totally-inclosed drives, V-belt drives with expanded-metal guards are used on the screens and the crusher, and all other equipment is driven through direct-connected right-angle herringbone speed-reducers. The screens have rubber lining at their impact and discharge points, while all chutes and spouts are lined with ¼-in. rolled manganese plate liners fastened with countersunk bolts. An original refinement is the use of revolving rubber brushes to keep the belt clean. These are driven by inclosed chain from the head-shafts of the conveyors.

The dustlessness of the plant is also due to forethought on the part of the designer. All chutes are fully inclosed to prevent spillage of materials and have conveniently-located hand-holes which allow inspection of the various products at any time. The No. 4 vibrating screen used for the sizing of fine dried material is inclosed in a separate room which is seldom entered except when the plant is shut down. The bucket-elevators are steel-inclosed and are made absolutely dust-tight with felt gaskets at the joints between sections.

Neatness and cleanliness are emphasized, every effort being made to improve the appearance of the plant. Waste-buckets placed on every floor are a constant reminder to employees that trash has no place on the floor of a modern plant. Another feature which helps to make this plant unique is that every operating unit and bin is plainly labelled so that even a stranger need never become lost or confused. All parts of the plant are well lighted with large, steel-sash, clear-glass windows and adequate lighting fixtures. The entire interior and exterior of the plant and all the machinery is painted aluminum, presenting an unusually attractive appearance. The grounds around the plant have been graded and thousands of cubic yards of dirt removed.



Triple-deck vibrating screen No. 2.



Plant from northeast with drier building at left.

The plant is located at the White Rock quarry

of the Kelley Island Lime & Transport Co. near Clay Center, Ohio, about 13 mi. southeast of Toledo on the main line of the New York Central Railway. The operations at this location are one of the twelve operations owned by the company in various states, the combined capacity of which make it the leading producer of lime and limestone products. At Clay Center hydrated finishing lime is the main product and all others are incidental to it.

The entire operation at Clay Center now consists of seven distinct units. In addition to the quarry there is a preliminary-crushing and screening plant, four vertical-kiln lime plants, a rotary-kiln lime plant, and the new fine-crushing and screening plant with which this article is concerned. The lime plants comprise a total of 53 vertical kilns and an 8-ft. by 150-ft. rotary kiln. They have a combined capacity of 600 tons of hydrated finishing lime per day, making the entire unit the largest producer of this material in the country.

Arrangement of chutes to bins and conveyor to drier.

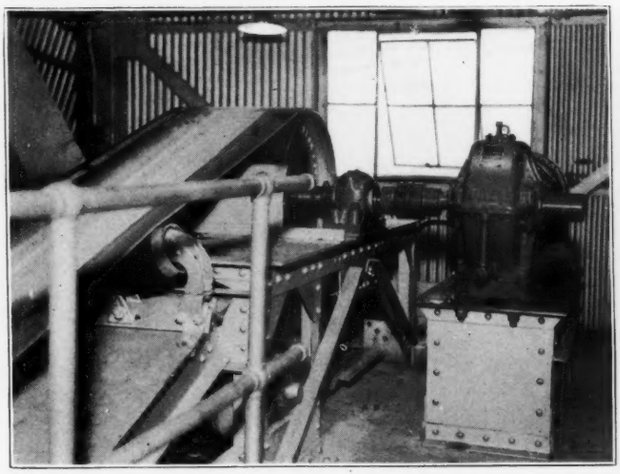
The quarry is one of the oldest now being operated in this district and is said to have been the site of the first plant manufacturing hydrated finishing lime there. The stone is quarried in the usual manner and is loaded into quarry cars by shovels.

Interior of conveyor junction-house showing feed to screening plant.

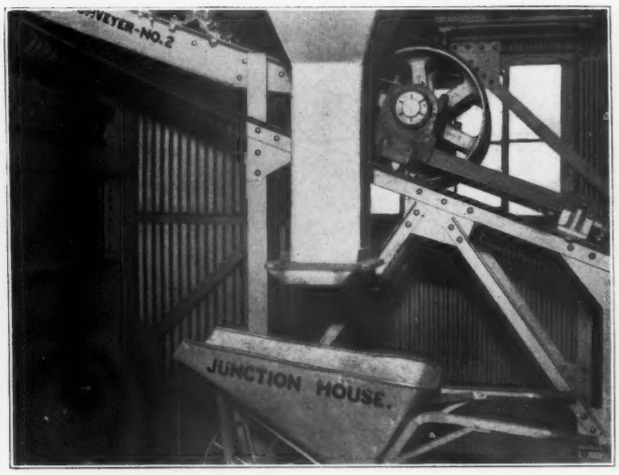
Steam locomotives haul the loaded cars to the foot of the incline, up which they are hauled by cable and hoist to the crushing plant. This plant does only the primary crushing and screening of kiln and flux stone and furnishes the material for all the other plants at this location. It was built in 1910 but has been remodeled from time to time to keep up with modern practice. The material from 2½-in. size down to be used in the new plant is stored in two surge bins with a total capacity of 200 tons. It is at this point that the new operation begins.

A variable-speed manganese-steel plate feeder (No. 1), 28 in. wide and operating on 10-ft. centers, feeds the material to an inclined conveyor (No. 1) which leads to a junction-house. This conveyor is 24 in. wide, operates on 110-ft. centers, and has a Dings high-intensity magnetic head-pulley, which is 30 in. in diameter and uses direct current furnished by a small motor-generator set in the same building. The iron removed from the stone drops into a chute with an opening on the floor below. A wheelbarrow is kept below this chute to remove the iron at regular intervals.

Conveyor No. 1 discharges to a second inclined conveyor (No. 2) which is placed at right angles to the first and carries the stone to the top of the fine-



Magnetic head-pulley of Conveyor No. 1 with hood removed.



Arrangement for disposing of metal separated by pulley.

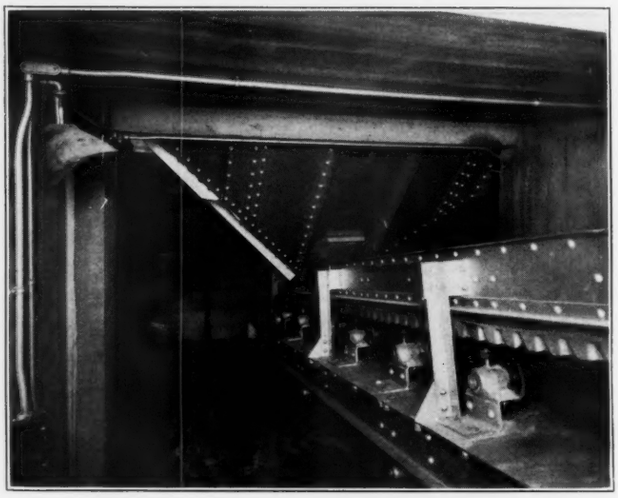
Looking down gallery of Conveyor No. 2.

screening building. It is 30 in. wide, operates on 144-ft. centers, and discharges to vibrating screen No. 1 on the top floor of the building. This is a 5-ft. by 8-ft. single-deck unit with 4-mesh cloth and is used to scalp off the fine material. A section of rubber lining on the screen protects the cloth at the point of impact of the material. The fine material can be chuted either direct to storage or to the drying plant.

The "oversize" from screen No. 1 is fed through a chute to screen No. 2 on the floor below. This is a 4-ft. by 8-ft. triple-deck vibrating screen with cloth of 1-in., ⅜-in. and 4½-mesh on its individual decks. This screen makes a finished No. 6 size of stone which passes through the ⅜-in. square opening and is retained on the 4½-mesh deck. This material is chuted directly to storage. The material which passes through the bottom deck, like that from the No. 1 screen, goes to the drying plant, the "oversize" from the two top decks being chuted to screen No. 3.

Screen No. 3 is a 4-ft. by 8-ft. triple-deck vibrating screen with 1¼-in., ¾-in., and ⅜-in.-mesh cloth on its individual decks. It produces finished No. 4 stone, which passes through the ¾-in. openings and is retained on the ⅜-in. cloth. It also produces finished No. 3 stone between the 1¼-in. and ¾-in. decks. Both these sizes are usually chuted directly to bin storage. The "oversize" from the top decks usually goes to storage as No. 1 stone and the material passing the ⅜-in. deck can also be chuted to storage.

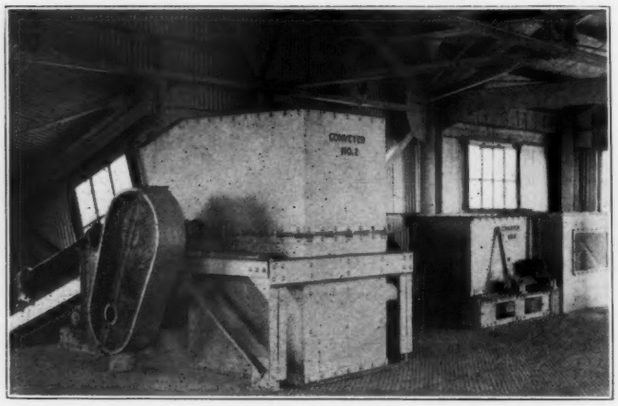
When desired, any of or all the sizes retained on the ⅜-in. square openings can be diverted by chute to one of four steel collecting bins of 100-ton capacity. A variable-speed manganese-steel plate-feeder (No. 2), 28 in. wide and set on 9-ft. 3-in. centers, carries this material to the 4-ft. short-head cone reduction crusher. This crusher is a recent development and was designed to produce small sizes of stone without an excess of "oversize." The crusher discharges to inclined conveyor No. 3 which carries the crushed material back to the gallery junction-house where it is discharged on conveyor No. 2, thus forming a circulating load for the plant.



Track hopper feeding to pan-conveyor.

Conveyor No. 3 is 24 in. wide and operates on 164-ft. centers.

All the material passing through the ⅜-in. openings on screens No. 1 and 2 can be diverted to horizontal belt-conveyor No. 4 which leads to a parabolic-bottom steel bin with a capacity of 150 tons. This conveyor is 24 in. wide and operates on 71-ft. centers. The bin feeds directly into a 7-ft. by 40-ft. indirect-heat rotary drier, which is coal-fired and has a capacity of 40 tons per hr. The drier discharges to a vertical bucket-elevator (No. 1), which has 12-in. by 7-in. buckets and operates on 94-ft. centers. This elevator in turn discharges to horizontal belt-conveyor No. 5, 24 in. wide and operat-



Conveyor No. 2 at left, Conveyor No. 4 at right.

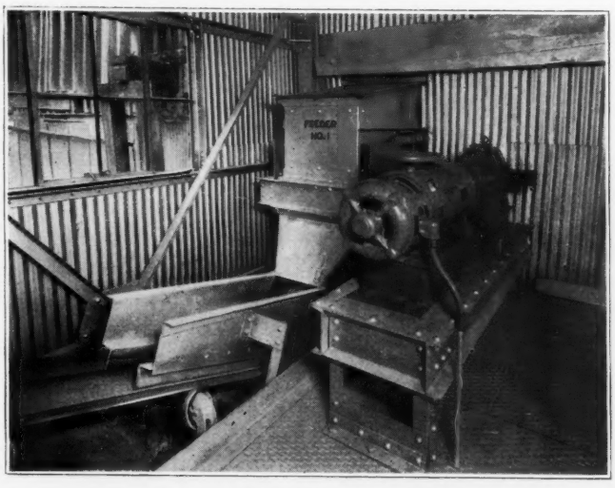
Speed-reducer drive of Conveyor No. 2.

View showing loading gates and walkways.

Loading trucks through special chutes.

ing on 18-ft. centers, which in turn feeds vibrating screen No. 4. This is a 4-ft. by 8-ft. triple-deck unit equipped with screen openings of from 100-mesh up to suit the trade's requirements.

The dried and sized material from the No. 4 screen is chuted to any of four steel storage bins of 220-ton capacity each. The larger sizes from the other screens are stored in four bins of 150-ton capacity each alongside the coarse bins. The bins are of the hopper-bottom self-cleaning type and are



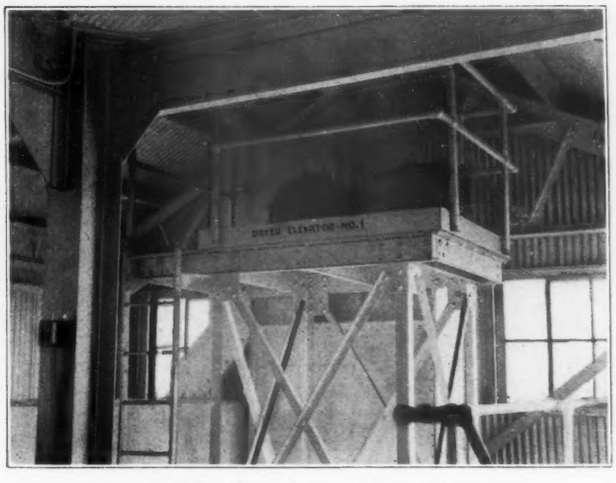
Feeder No. 1 from preliminary crushing plant.

arranged in two rows over two standard-gauge tracks for loading railway cars. Loading is done through duplex quadrant gates. The four west bins have special spouts for loading trucks. Three of the fine-material bins have spouts so arranged that box-cars can be loaded on either track in conjunction with a box-car loader. Steel stairs and walkways under the bins give access to the loading controls from the mill or from either side of the tracks without necessitating crossing the tracks.

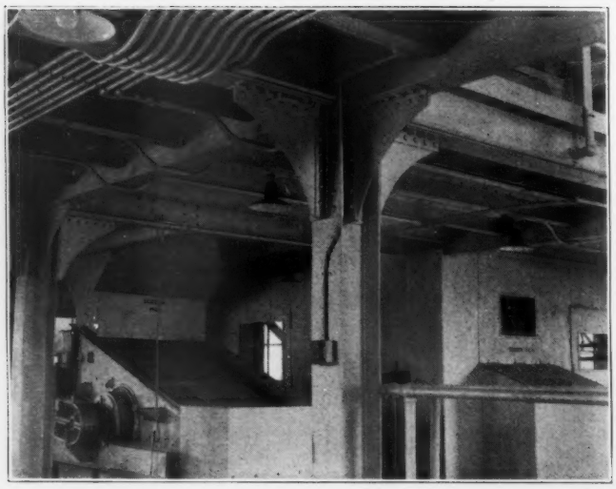
The reclaiming of stored material to be recrushed is also provided for. Cars are loaded with this material under the bins and are emptied into a 12-ft. by 12-ft. track hopper located at the south end of the building. A rod-grizzly with 4-in. square openings protects this hopper. A manganese-steel reclaiming-apron conveyor, which takes the material from the hopper, is 28 in. wide, operates on 16-ft. centers and is set on a slight incline. It discharges to reclaiming elevator No. 2, which has 12-in. by 7-in. buckets and operates on 72-ft. centers. This discharges through a spout to a special manganese-steel turn-head chute arrangement for feeding to any of the four 100-ton bins previously mentioned.

From the electrical angle the plant is as far in advance of most modern practice as it is from other angles. All the motors used for the conveyors and elevators are of the across-the-line start double squirrel-cage type and, with the exception of the screen and crusher motors, all have a speed of 720 r.p.m. The screen motors have a speed of 1,500 r.p.m. The crusher motor is a 150-hp. Westinghouse Type HG synchronous machine of a type new to this industry. It has a 40-per cent. leading power-factor which furnishes power-factor correction for the entire plant.

All the motor controls are interlocked and are operated from a central control-station on the eighth floor of the screening building. This station consists of a panel with push-buttons for each unit of equipment and for each unit a red-light signal which lights when this unit is in operation. The interlocking arrangement makes it impossible to start any unit of equipment except in the order



Elevator No. 1 from drier building.



Screen No. 1 at left with inclosed screen No. 4 at right.

of the flow of the material through the plant. The plant operator standing at this board can see most of the units from his post. Each unit also has its individual push-button switch located near the motor for use in case of an emergency. This switch can be locked when work is being done on the unit and no one but the man locking the switch is permitted to unlock it.

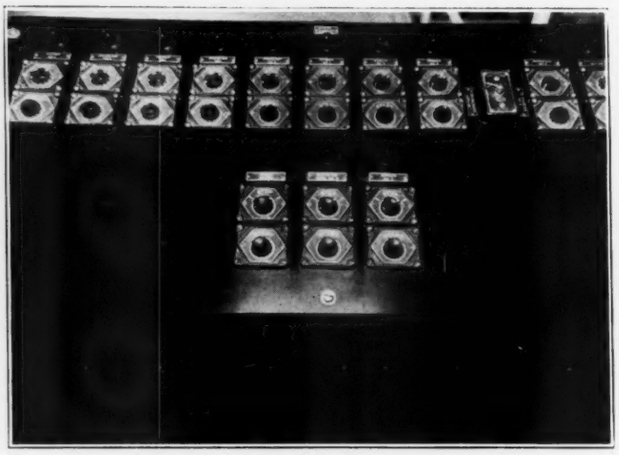
The motors used in this plant are divided between General Electric and Westinghouse. Crouse-Hinds conduit, Cutler-Hammer starters and starting switches, and Bulldog safety switches are used throughout.

The American Bridge Co. furnished and erected all the structural-steel framework of the plant, the steel bins and the steel stairs, walkways and floors and the 1½-in. pipe hand rails which contribute so much to the appearance of the plant. The Stephens-Adamson Mfg. Co. furnished the welded-steel chutes, the conveyor pulleys, idlers and drives, the vibrating screens, the bin gates, the bucket-elevators and housings, and the two J. F. S. variable-speed reducers. The latter are of the latest improved type with self-contained 2-hp. motors and speed indicators. Goodyear rubber lining is

Electrical equipment and crusher-drive motor.

used on the screen discharge chutes. The Symons 4-ft. short-head cone reduction crusher, furnished by the Nordberg Mfg. Co., of Milwaukee, is the first of its type to be installed in the crushed-stone industry.

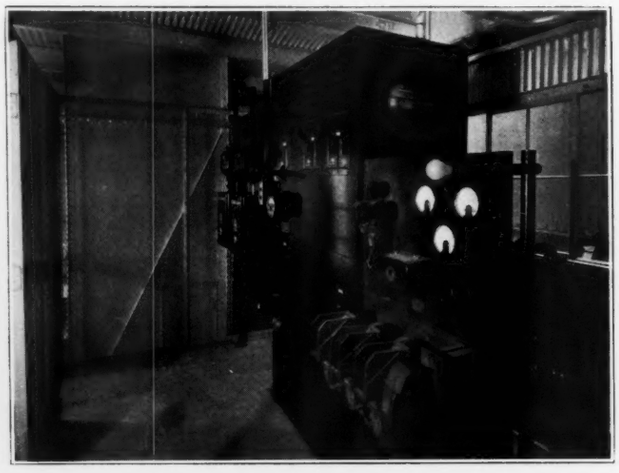
The conveyor belting was furnished by the Robins Conveying Belt Co., and the right-angle, herringbone speed-reducers by the Falk Corp. Falk flexible couplings are used on the high-speed shafts



The master control-board.

of the reducers. Dayton Cog-Belt drives are used on all the vibrating screens and a Texrope drive on the Symons crusher. Taylor-Wharton Timang rolled-manganese chute lining is used throughout. All the buildings and galleries are inclosed with Cop-R-Loy corrugated sheet metal and present a neat appearance.

The entire plant was designed by Joseph J. Schedel, consulting engineer for the Kelley Island



Part of electrical equipment on first floor of plant.

Lime & Transport Co. All the equipment was furnished to his specifications and all the construction and installation of equipment was done under his supervision. All the work, except the erection of the steel, was done by the company's own forces, including the pouring of foundations, installation of machinery, electrical equipment, conduit, etc.

Minimizing Hazards of Pulverized-Coal Dust About Cement Plants*

By D. B. COLEMAN
Safety Director, Missouri Portland Cement Co.

WITHIN the coal-mill building the best way to prevent the formation of dust in dangerous quantities is to keep the place scrupulously clean. One operator saw his department filled with flames when vibration from a quarry shot brought down clouds of dust from the rafters. Unfortunately the fire door to the drier furnace was open at the time. Another had a similar experience when a compressed-air line broke, blowing dust toward the furnace.

The work of house-cleaning must be carefully planned and executed, for in such an arbitrary measure one certainly would not want to create the very condition we are trying to avoid, namely, dust formation. As was the weekly plan in one plant, a hose was turned into the drier furnace and all fires apparently extinguished. A crew of ten men were put to work sweeping down coal dust, starting from the top of the building. Within a few seconds the entire place was filled with dust. From some unexpected source it was ignited. Nine of the ten men were burned to death.

The road to another accident was paved with good intentions when compressed air was used to blow the dust from the tops of the boilers in a power-plant. Naturally, it was immediately put in suspension and exploded when it reached the fire door of the boiler.

As an aid to safe cleanliness it is recommended:

1. That buildings be designed to secure the minimum lodgement of dust. With this in mind, one coal building was actually built with the siding on the inside of the purlins. In existing buildings it may mean putting sloping shields over the purlins and roof members, on which dust can not accumulate.

2. That, wherever possible, the building be designed so that the interior parts on which dust might lodge will be accessible for cleaning.

3. That the inside surface of walls be as smooth as possible.

4. That there be a liberal use of white or light-colored paint. It will not only give more light but will have a marked psychological effect.

5. That screw-conveyors and belts be carried on solid flooring to prevent excessive dust formation in the case of spill.

6. That dust in the building be avoided by the use of dust-collectors. If a cloth type is used it should be inclosed in a metal case and the fabric electrically grounded.

7. That, if compressed air must be used, it be employed only in connection with a water spray after careful experiment. Air may be used for blowing out motors and such inaccessible places, but it is advised that this be done just after the room has been cleaned.

8. That if large quantities of dust must be swept, it be carefully wet down prior to sweeping.

9. That a vacuum-cleaner is most desirable. In the event it is installed: (1) It should be of the permanent type, because of the hazard attending the use of the flexible cable on the portable type; (2) the nozzle and handle should be of non-ferrous metal, fiber, or other non-sparking material; (3) the hose, nozzles, handles, and other metal parts should be electrically grounded to the piping system and that system in turn grounded to the earth; (4) dust separation should take place before the dust reaches the exhauster; the discharge of the separators shall be carried outside the buildings; (5) the motor and separator should preferably be located outside the pulverizer room.

Dust within the equipment presents an extreme hazard because of its confinement. When ignited. there is usually a wreck with personal injury or loss of life.

Two repairmen entered an elevator casing, one carrying a lighted torch. The other man hit the chain with his hammer, intending as a joke to shower his partner with dust. Both men were blown out through the top of the casing; one was killed and the elevator was wrecked.

Six men entered an almost empty coal bin to shovel out the remaining coal. Of course, there was a cloud of dust which, by some means, was ignited. The bin was wrecked and six men burned to death.

A night-shift oiler was forbidden to bring his lantern, which he carried coming to work, inside the coal-room. One night he "got by" with it and used it inside the mill while oiling the rolls. He apparently forgot his lantern, then closed and started the mill. He and the mill were blown to pieces, another man was burned to death, and the building was wrecked.

At two different plants coal-tank men lifted the covers to inspect tanks which were being filled. In each case a cloud of dust drifted out, became ignited, burned the men to death and wrecked the bins.

To prevent explosions of the type just mentioned, it is recommended:

1. That all equipment be kept as dust-tight as possible.

2. That safety relief vents be provided on all necessary equipment.

3. That tank vents be large enough to prevent building up abnormal pressure therein. Safety relief vents from pipes or flues should have at least the same area as the pipes or flues vented, and should lead by the shortest possible vertical direction to the outside air.

* Read at the 1931 Regional Meeting of Portland Cement Assn. at St. Louis, Mo.

4. That all tanks have smooth inside surfaces and be so shaped that the minimum of material hangs up in the corners.

5. That all joints be riveted, and the rivets spaced to insure a dust-tight joint, and the joints caulked or welded.

6. That the bin be so designed that the coal is introduced tangentically against one of the sides in order to reduce the size of the dust cloud.

7. That all bins be equipped with high bin signals.

8. That no manhole or inspection door be opened while the tank is being filled.

9. That hammering on hoppers be prohibited, for it eventually causes leaks.

10. That no mill or elevator be entered within 20 min. after a shut-down in order that the dust may settle.

11. That, when working in equipment, there be the least possible creation of dust.

Obviously if we are successful in our efforts to prevent the formation of dust, there is no ignition problem. However, we will have to reach the idealistic stage before we can disregard this hazard.

Explosions are caused by open fires, electric sparks, metallic sparks, spontaneous combustion, driers, and smoldering fires in equipment.

Torches in a coal-room constitute a flagrant violation of good sense. Four men were burned in an elevator casing from the resulting explosion when one of them entered with a lighted torch.

At another plant an operator opened an elevator casing to tighten a loose chain. He set a torch, borrowed from the kiln-room, in one of the buckets and shook the chain to see how loose it was. A cloud of dust came down, ignited and burned him so fearfully he died shortly thereafter.

On any number of occasions flashes have resulted from coal dust being blown to an open furnace and the kiln-hood doors.

All open lights, torches, salamanders, and smoking should be prohibited in the coal-room.

Coal tanks should be located as far from the kiln hoods and dried furnaces as is consistent with operating requirements.

That part of the building around the firing end of driers and kilns should be kept particularly clean of coal that might be carried, by wind or vibration, as dust to the fire doors.

Even locomotive sparks are a source of ignition, as shown by the fact that of 78 grain-dust (very similar to coal dust) explosions and fires in 1929, 15 were traceable to this source.

Electrical equipment is an occasional source of ignition. In one plant a short-circuit of one of the armature coils of a 25-hp. 500-v. d-c. motor ignited the coal dust accumulated inside the motor casing and initiated the explosion of dust throughout the building.

Another explosion was caused by an electric spark from a blown fuse on the switchboard at the very moment that a cloud of dust was formed by the breaking of a 6-in. drive belt.

A $650,000 explosion in a Kansas City grain elevator in 1919 killed 14 men and seriously injured 10 others. Evidence indicates that a short-circuit was caused by a defective extension cord or by breaking an unprotected light bulb in a dusty atmosphere.

There are any number of cases where light globes have been broken or exploded in coal tanks, the glowing filament then igniting the suspended dust in the tank.

Several explosions in a plant, one of which seriously injured 6 men, resulted in the discovery that a 20,000-v. charge of static electricity was being built up and discharged in a cloth-type dust-collector.

Other causes of static charges are the contact of rapidly-moving parts of machinery, such as belts, rollers, balls in pulverizing mills, fan blades and particles of fine material being rapidly conveyed through chutes and spouts.

To reduce the fire and explosion hazards of electrical equipment, as just illustrated, it is recommended:

1. That, as far as possible, all wires and cables in the coal-pulverizing department be carried in conduits.

2. That, unless the coal-room is kept free from dust, switches be placed outside the building. If this is not feasible, they should be of the oil-immersed type.

3. That provisions be made to cut off the light and power at some remote point in the event of an explosion or a fire. This avoids the need of entering the building.

4. That motors not properly inclosed or protected against ignition by sparks at the commutator have no place in the coal-room. Motors of the non-sparking type, preferably squirrel-cage motors, are the most nearly explosion-proof now available.

5. That the bulbs on extension cords be protected by heavy wire guards and that connections and insulation be inspected frequently. It is even more desirable that lights of the flashlight type be used instead of extension cords.

6. That, where there is any possibility of the formation of a static charge, the equipment be grounded. This will dissipate the charge as it is generated.

7. That coal tanks, conveying lines or pipe-lines should not be used as supports for light or power lines, except where such lines are carried in conduits.

Lack of evidence of explosions due to metallic sparking does not mean that the hazard is unimportant.

Magnetic separators should be provided ahead of all pulverizers of other than ball- or tube-mill type. Coal that has passed the separator should then be protected to prevent the reëntry of foreign material. Separators should be protected by interlock or alarm systems to prevent the passage of coal when not magnetized. In connection with sparking, it is interesting to note that the National Board of Fire Underwriters states that "non-ferrous metals need not be used in the construction of fan blades or lining of fan casings."

Unsuspected fires in equipment have caused im-

mense damage. In one case the boilers were shut down and the fire apparently killed for the regular weekly inspection of the coal-mill. The fan was started to clear the mill of coal, the dust blown into the boiler. A few minutes later there was a terrific explosion, the dust having been ignited by some embers in the fire-box. The shift engineer was blown into the air and killed, the superintendent and mill operator were sent to the hospital for four and eight months, respectively, and the boiler-room wrecked.

In another coal-grinding department the building was wrecked and 12 men were killed when the department was again started after a fire in an elevator-boot was thought to have been extinguished.

In another plant an explosion burned 8 repairmen to death. While the mill was being repaired one of the men rammed a stick with some waste on it into the part he was cleaning. Smoldering fire apparently ignited the waste, which in turn ignited the dust created by the repair work. There was a flash in the mill and then flames traveled back and forth several times across the room with a strange hissing noise, apparently the result of dust shaken from overhead by the first flash in the mill.

It is recommended:

1. That, when the fan is to clear the mill of coal, the induced-draft fan be placed in operation or the stack draft be wide open before the mill and exhauster fan are started.

2. That a lighted torch always be placed in front of the burner, even though the boiler or kiln is down.

3. That the system be so interlocked that the mill and fan can not be put in operation ahead of the induced-draft fan.

4. That all equipment be regularly inspected for smoldering fires, particularly before being opened for repairs. A fire may smolder in the system in operation without damage, due to the lack of air. Opening the system and starting repair work may create the proper dust suspension for an explosion.

5. That, when a fire is found in equipment, except tanks, it be carefully flooded with water and then shoveled out of the system.

Spontaneous ignition, though a serious problem, never causes an explosion unless the dust is stirred up, allowing suspension in the air. To prevent spontaneous ignition it is recommended:

1. That a study be made of the coal used at each plant to determine its susceptibility to spontaneous ignition.

2. That storage tanks be located as far as practicable from boilers, kilns, steam pipes, or other sources of heat.

3. That they be regularly inspected inside and outside when coal is stored for any length of time to determine whether there is any increase in temperature or whether there are fumes from smoldering fires.

4. That, whenever a plant is idle for more than two days, all tanks be thoroughly inspected before resuming operations.

5. That, whenever possible, all pulverized coal should be burned before the plant goes down.

6. That no coal, crushed or pulverized, be stored when its temperature exceeds 150 deg. F.

Now for the drier. There is almost no doubt that the keystone to safe operation of a coal department is in the proper operation of this piece of equipment. The majority of explosions and fires can be traced directly or indirectly to overheated coal, which is generally caused by either too hot a fire in the drier furnace or the continuance of the fire after the drier has been shut down with coal in it.

One typical case from the many will suffice. The pulverizing mill in a cement plant had been shut down for full kiln tanks. Just as it was being started a few hours later it exploded. The attendant shock brought down accumulated coal dust from overhead and this in turn exploded, wrecking the building. Two men were killed. The investigation proved that the explosion was due to one of two sources. Either some hot coal remained in the mill when shut down and grew hotter until it needed only the additional air supplied by the simultaneous starting of mill and fan, or, due to the drier operator's neglect, the coal was practically red hot when fed to the mill.

To help in the safe operation of driers, it is recommended:

1. That equipment be so interlocked that, when the drier is shut down, there is no continued heating of the coal.

2. That operation be controlled by temperatures taken of the coal at the discharge of the drier. Such control compensates for variations in coal moisture and feed. Usually 90 deg. to 125 deg. F. on the drier discharge will dry most coals satisfactorily.

3. That there be a temperature indicator and alarm system in the range of vision and hearing of the drier operator.

4. That, if the coal is at all variable, automatic temperature-control systems may be a good investment.

5. That, when necessary to reduce drier temperatures, this be done by lowering air temperatures rather than air quantities.

6. That, in direct driers, the gases of combustion should not come in direct contact with the coal before at least one-half way back in the drier and, in no event, within 12 ft. of the fuel bed.

7. That the drier be run empty before being shut down.

8. That shavings or other light inflammables should not be used in starting drier-furnace fires.

9. That operating schedules be so arranged that no dried coal is stored for more than 24 hr.

10. That the drier operator be a reliable man who thoroughly understands his business.

Overheating of bearings is another source of ignition. This hazard may be eliminated by frequent inspection and oiling, by keeping the bearings, in fans particularly, on the outside of the equipment, and, in case of unusual hazard, by a bearing-alarm system.

A coal-dust explosion can not be handled. It must run its course. If it is not prevented, the next best measure is to see that there is sufficient fire-fighting equipment to fight the subsequent fire, to be used

(Continued on page 49)

The Nonmetallic Mineral Resources of ARKANSAS

By GEORGE C. BRANNER
State Geologist

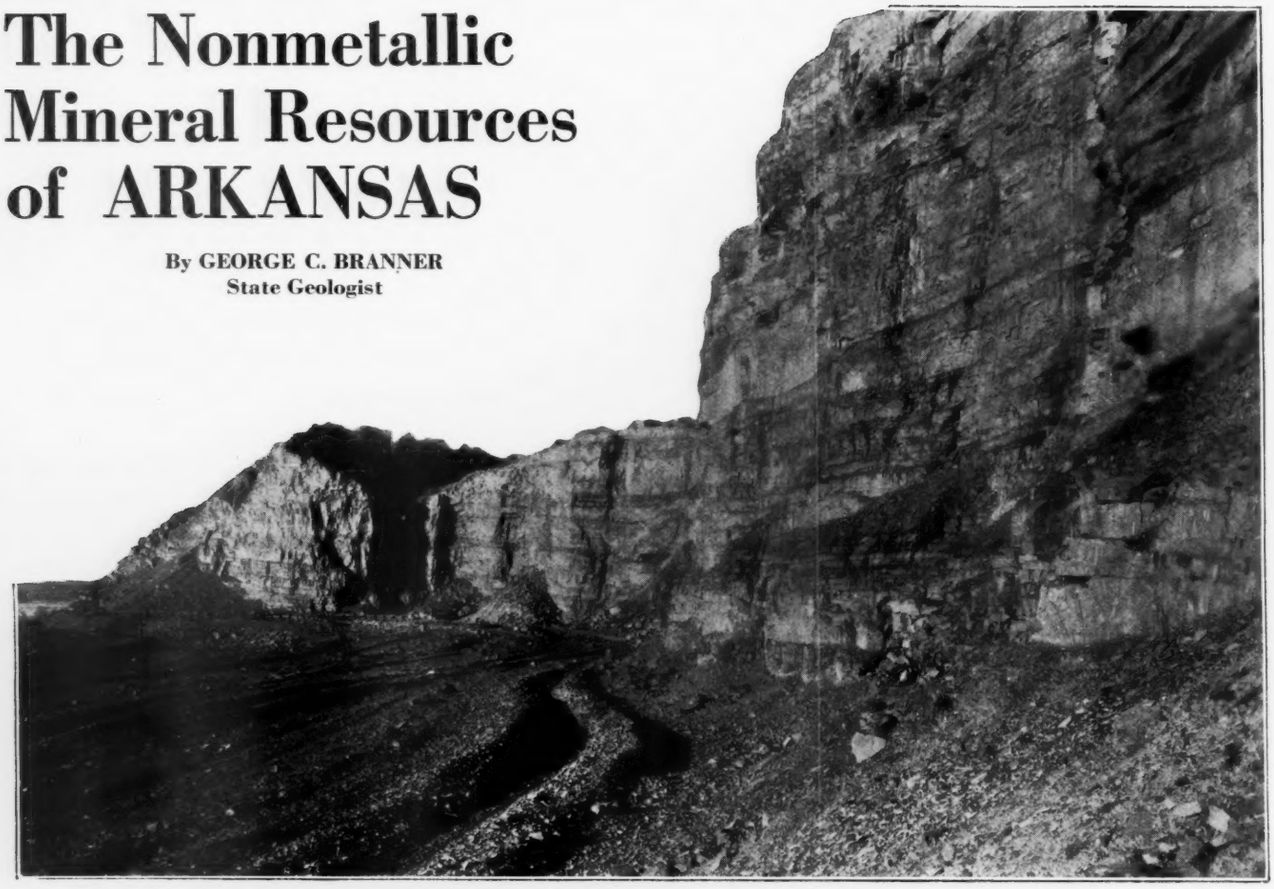


Fig. 1. Quarry of Big Rock Stone & Material Co. near Little Rock, Ark.

DURING the thirty year period from 1900 to 1929 inclusive, the value of the nonmetallic minerals produced in Arkansas (not including fuels or bauxite) was $66,169,704. During 1929 the value of the nonmetallic minerals produced in Arkansas was approximately $5,211,854. If we include 52.7 per cent. of the value of the bauxite produced in Arkansas during 1929—this amount being used in the manufacture of nonmetallic-mineral products—the total value of the nonmetallic minerals for 1929 was $6,361,324.

During the 30-yr. period referred to, the value of the nonmetallic minerals increased at a slow but fairly constant rate, the value of the 1929 production being the maximum for the period. During the same 30-yr. period the value of the nonmetallic minerals was 53.7 per cent. greater than that of the metallic minerals ($43,766,317), and during only four years of this period did the value of the metals exceed that of the nonmetals to any appreciable extent. These years were 1915, 1916, 1917 and 1918, which were during the war period and a time of high metal prices. Fig. 2 shows the annual value of the nonmetallic minerals during the 30-yr. period.

The principal nonmetallic-mineral products of Arkansas in the order of their relative values are: Clay products; sand and gravel; bauxite; stone; lime; cement; oilstones; tripoli; and glass sand.

The quantity and value of nonmetallic minerals produced in Arkansas during 1929, according to the U. S. Bureau of Mines and other sources, are shown in the table.

The different nonmetallic resources will be discussed in the order of their value.

Clay and Clay Products.—Clays are widely distributed over the state. Those of the Lowland or Gulf Coastal Plain region are the better-grade clays and are used in the manufacture of brick, tile, refractories, stoneware, sewer-pipe and pottery. The clays in the Arkansas River valley and Ouachita Mountain areas of the Paleozoic region are, for the most part, shales and mudstones and are used to a limited extent in the manufacture of brick and tile. Relatively small quantities of clays suitable for the manufacture of clay products are found in the limestone and dolomite areas of northern Arkansas.

Cheap natural gas and the proximity to important railroad trunk lines in central and southern Arkansas have been vital factors in the development and operation of the brick, tile, and pottery plants.

PRODUCTION OF NONMETALLIC MINERALS IN ARKANSAS, 1929

Material	Production	Producers	Value	Relation to Total Value (*per cent.*)
Clay products (not including pottery)	.....	10	$1,961,283	30.88
Clay, raw	.....	.....	2,883	.....
Sand and gravel	*short tons* 3,992,336	83	1,851,755	29.11
Bauxite (52.7%)	*long tons* 185,005	5	1,149,470	18.07
Stone	*short tons* 551,730	13	761,064	11.97
Lime	*short tons* 33,647	4	295,816	4.64
Cement	*bbl.* 175,000	1	220,000	3.47
Oilstones	*short tons* 171	2	115,684	1.81
Tripoli	*short tons* 345	1	3,369	.05
			$6,361,324	100.00

The value of the clay products (excepting pottery) manufactured in Arkansas during 1929 was $1,961,283. According to the state severance tax records, nine companies, including two potteries, were engaged in the clay-products industry in 1929 and eight companies, including two potteries, operated in 1930. The plants now operating in this state have a combined estimated annual capacity of 193,000,000 brick and 600,000 pieces of pottery.

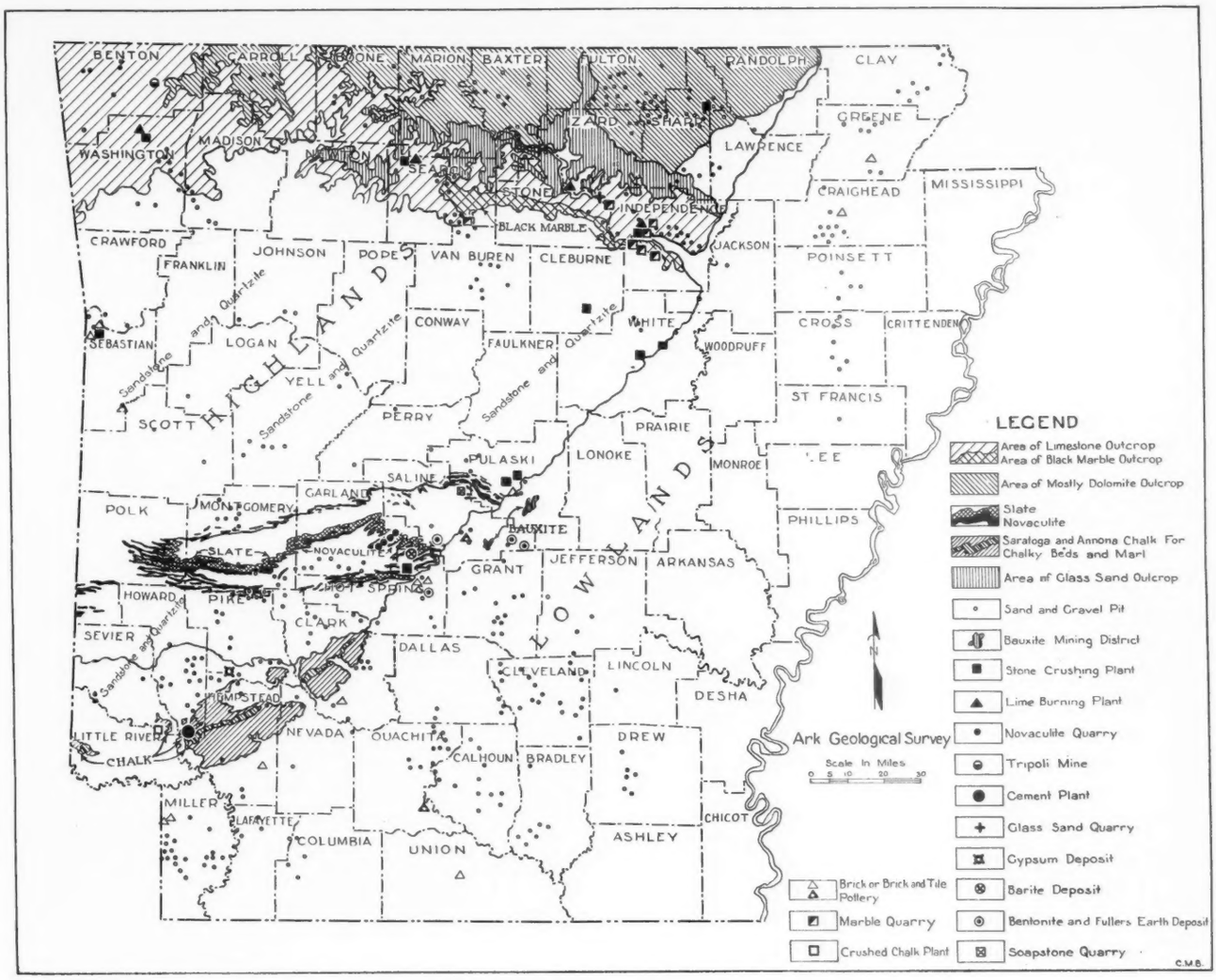
Sand and Gravel.—During 1930 139 firms and individuals reported production of sand and gravel. The major portion of the producers (124 or 89.2 per cent. obtained their material from the terrace gravel deposits of the Gulf Coastal Plain and 15 (10.8) per cent. secured their material from the beds and bars of streams. During 1929, 3,992,336 short tons of sand and gravel were produced with a value of $1,851,755. During 1930, the estimated production of sand and gravel was 2,821,955 short tons with an estimated value of $1,567,836.

The greater part of the sand and gravel produced was used for state-highway construction and the future production will be controlled largely by the highway-building and maintenance program. The reserves are, to practical purposes, unlimited. The locations of the pits are shown on the map below.

Bauxite.—The Arkansas bauxite deposits are unique in that they are the source of nearly all this mineral produced in the United States. In 1929 the state production was 351,054 long tons, or 95.9 per cent. of the amount produced in the United States (365,777 long tons) or 47.0 per cent of the total tonnage consumed in the United States (746,589 long tons). The following table gives the estimated amounts of bauxite produced in the United States and which were used in the manufacture of metallic and nonmetallic products in 1929:

Industry	*Long Tons*	*Per Cent.*
Aluminum	172,807	47.3
Chemical	86,419	23.6
Abrasive	99,925	27.3
Refractories and cement	6,626	1.8
	365,777	100.0

From the above, it follows that 52.7 per cent. of the total bauxite produced in this country was used in the manufacture of nonmetallic products. If we apply this same percentage to the Arkansas production, the value of this part of the total tonnage mined was $1,149,470.



Map of Arkansas showing distribution of nonmetallic minerals and plants, pits and quarries.

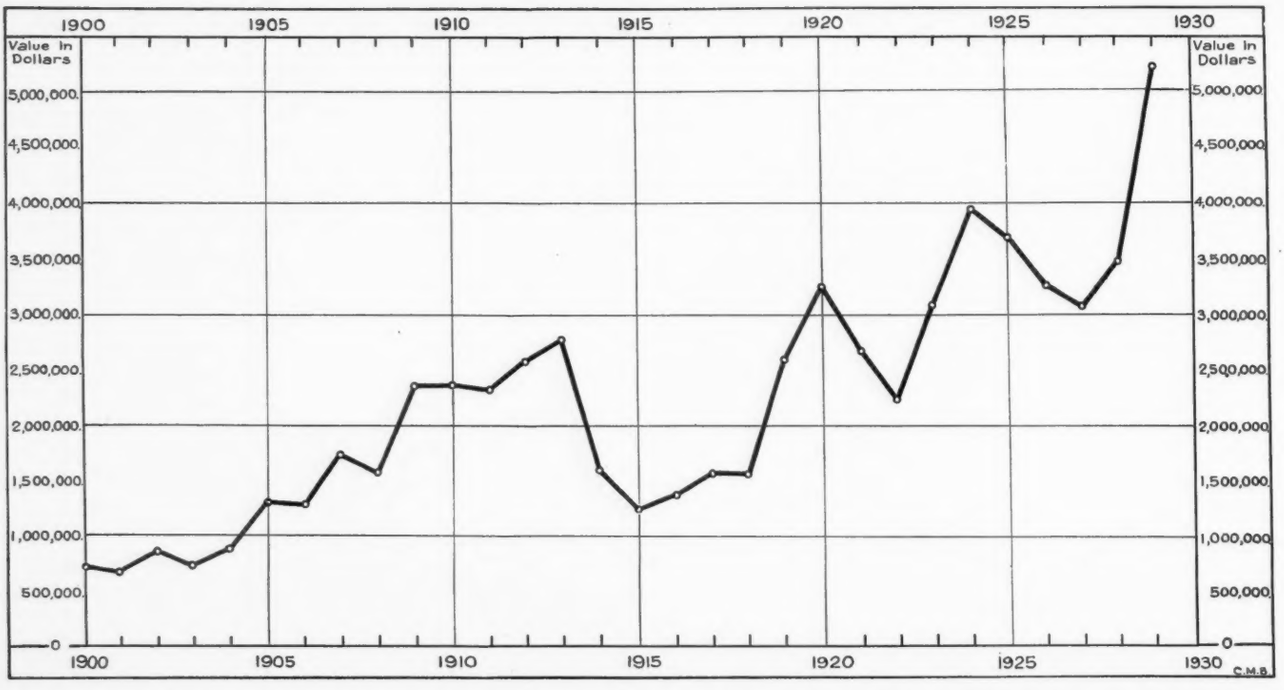


Fig. 2. Chart showing annual value of nonmetallic-mineral products in Arkansas from 1900 to 1929. Does not include fuels or bauxite.

The bauxite deposits in Arkansas are residual products of the nephelite syenite ("granite") which is exposed in Pulaski and Saline Counties. Approximately 60 per cent. of the ore is mined by underground methods, mainly by retreating caving, and about 40 per cent. is mined by open-cut methods.

The bauxite-production area of Arkansas is located in the central portion of the state, south and southeast of Little Rock. This area is divided into two separate mining districts: (1) the Bauxite district in Saline County, which has produced about 91 per cent. of the ore, and (2) the Fourche Mountain district in Pulaski County which has produced about 9 per cent. of the ore. Three mining companies are now operating as follows:

Saline County—Republic Mining & Mfg. Co., Bauxite, Ark. (Fig. 3).

Pulaski County—Republic Mining & Mfg. Co., Sweet Home, Ark.; Dixie Bauxite Co., Sweet Home, Ark.; W. J. Crouch, Little Rock, Ark.

The Republic Mining & Mfg. Co. has plants in both counties and produces most of the ore mined. Its Bauxite, Saline County, plant is equipped with nine driers and four calciners.

The Dixie Bauxite Co., which produces ore only for the nonmetallic mineral trades, is operating the only shaft mine in the state at the present time and a description of the deposit and mine is of interest. The deposit is lenticular in shape and covers an area of about 10 acres, has an overburden of from 60 to 65 ft. and is mined by shaft and tunnels. The shaft is located in the thickest portion (about 60 ft.) of the deposit and at the lowest point. About 40 ft. of the central portion of the lens is made up of ore containing 58 per cent. or better of Al_2O_3.

There are two main levels and two sublevels of workings in this mine, having an aggregate length of about ¾ mi. Main levels are at 92 and 119 ft., with sublevels at 75 and 105 ft. Drainage is by gravity to a sump at the bottom of the shaft. Tracks are on the main levels only. From the sublevels ore is dumped through rises into the cars on the main levels beneath. The mill is equipped with one drier and one calciner, having 24-hr. capacities of 150 tons and 45 tons, respectively.

Recent geological reports indicate that undiscovered bauxite reserves of Saline and Pulaski Counties may be much larger than before thought probable and that the territory in which exploration can logically take place includes an area of about 165 sq. mi.

Crushed Stone.—Stone-crushing operations are limited to the Upland portion of central, northern and western Arkansas, indicated on the accompanying map as "Highland." Throughout practically this entire region are adequate supplies of hard rock for crushing. In the Arkansas Valley region sandstone and quartzite are the principal hard rock;

Fig. 3. Approach to Davis Portal and below—ground workings in bauxite, Saline County. Bauxite exposed at bottom of bank at right.

in the Ouachita Mountains are sandstone, quartzite and novaculite; and in the Ozark Region are limestones, dolomite, chert and sandstone.

The Big Rock Stone & Material Co. plant near Little Rock (Fig. 1) is one of the largest stone-crushing plants in the South. It is equipped with crushers, dredges, steam-shovels, tow boats and barges and has a daily capacity of 50 car-loads of crushed stone or "blue trap." This company also dredges sand from the bed of Arkansas River and has a daily capacity of 30 car-loads. It also operates a ready-mixed concrete plant (Fig. 4).

The Kelly & Evans plant at Fort Smith, equipped with a steam-shovel and three crushers, has a daily capacity of 500 tons and produces crushed sandstone.

The Williford Crushed Stone Co., Williford, produces crushed dolomite, agricultural limestone, and rip rap. This plant is equipped with five crushers, a pulverizing mill, two steam-shovels, and has an annual capacity of 500,000 tons.

The Red River Crushed Stone Co. plant near Heber Springs on Little Red River is equipped for crushing, screening and grading 15 car-loads of "blue trap" (hard sandstone) daily.

The Chicago, Rock Island & Pacific Railroad has a plant equipped for crushing novaculite at Butterfield, Hot Spring County. The capacity of this plant is 320 cu. yd. per day.

The Anderson Stone Co., Inc., plant at Johnson, Arkansas, is equipped to crush 400 tons of Boone limestone every 10 hr.

The Batesville White Lime Co. plant at Limedale, has a capacity of 500 tons of crushed limestone

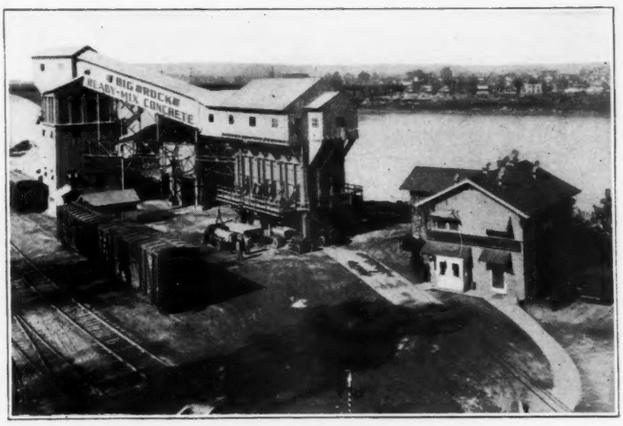


Fig. 4. Ready-mixed-concrete plant of Big Rock Stone & Material Co., Little Rock.

daily. This is used principally for railroad ballast and is produced in connection with lime-burning operations.

Other plants in the state equipped for crushing stone, but which were not reported as active during 1930, are:

The Little Rock Stone Co. plant 2 mi. northwest of Little Rock on the Rock Island railroad which is equipped with three crushers and has a daily capacity of 300 tons of rip rap and 100 tons of crushed rock.

The Mississippi River Commission sandstone quarry near Bee Rock on Little Red River. Sandstone from this quarry is used for revetment work on Mississippi River.

The Arkansas Lime & Stone Co. plant near Mercer was destroyed by fire in the summer of 1931 and has not been rebuilt.

The Little Rock Granite Co. plant south of Little Rock is equipped for crushing 80,000 tons of granite for railroad ballast annually.

The S. G. Cazort plant at Lamar, Johnson County, is equipped to crush 5,000 tons of sandstone annually.

The Pinnacle Stone Co. at Pinnacle, Pulaski County, is equipped to produce rip rap and building stone.

Building Stone.—The building stones quarried in Arkansas are for the most part marbles. A relatively small amount of sandstone is used both from bedded deposits and that occurring as country rock in the Highland district of northern Arkansas.

Fig. 5. Marble quarry of St. Clair Marble Co. at Guion, Izard County.

Limestone and dolomite are used to some extent locally for building.

Marble.—During 1930, marble was quarried in Arkansas by the following firms:

The Batesville Marble Quarries, Inc., which produced gray marble at its quarry near Batesville. The plant is equipped with four marble-sawing gangs and a tile plant, is electrically operated, and has a capacity of one car-load of marble slabs each 30 hr. The marble quarried by this firm is known as "Batesville" and is widely used in the United States and Canada both as an interior and exterior stone. It is quarried from the Boone limestone.

The Independence County Marble Co. operates a small quarry near Limedale, in the Boone limestone. The stone is sold in quarry blocks.

The St. Clair Marble Co. produces what are known to the trade as "Fernvale," "Kimmswick" and "Plattin" marbles at its quarry about 1½ mi. south of Guion, Izard County (Fig. 5).

These marbles differ in appearance from other Arkansas marbles now on the market and are mot-

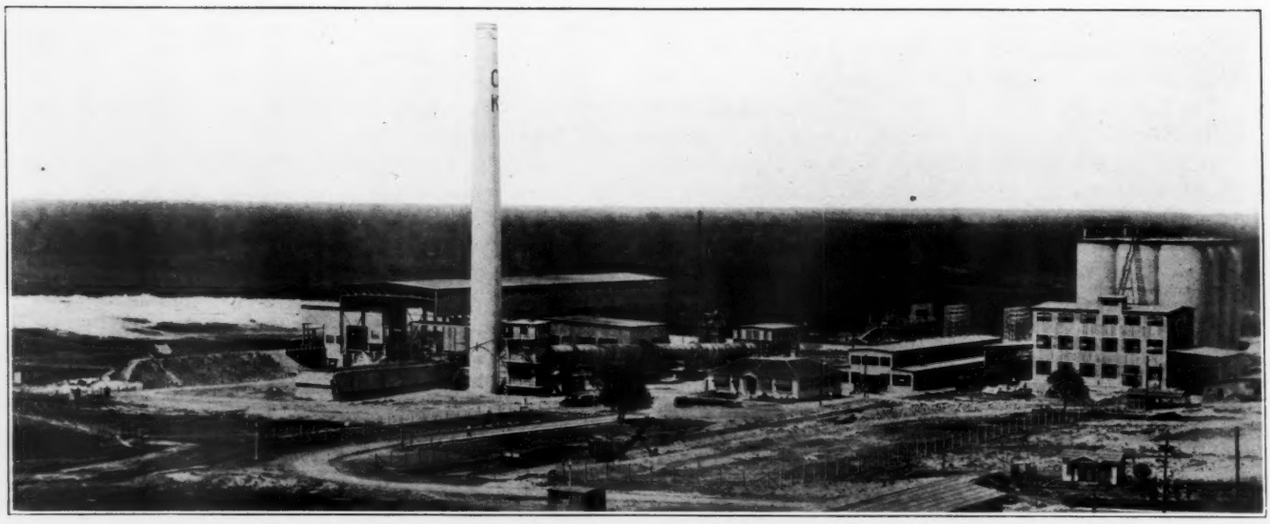


Fig. 6. Plant of Arkansas Portland Cement Co. at Okay, Howard County. Chalk quarry in background.

tled dark and light gray, brown and pink. The gray marble closely resembles the Tennessee gray marble.

The relatively recent discovery of black marble or limestone in north Arkansas is of considerable interest, as it is to some degree a competitor of Belgian black marble as an interior-decorating stone. The thickness of the deposits, as determined by the Arkansas Geological Survey, varies from 6 in. to 56 in., and has been traced for about 100 mi. from near Marshall, Searcy County (Fig. 8), to near Oil Trough, Independence County.

The Batesville Black Marble Co. operated three black-marble quarries in Independence County during 1930. These are located at the following places: Sec. 8 and 9, T. 12 N., R. 6 W., Sec. 22 and 27, T. 13 N., R. 7 W., and Sec. 27 and 34, T. 13 N., R. 7 W. This company has a terrazzo-crushing plant.

S. O. Denton has opened a black-marble quarry at Leslie in Searcy on the M. & N. A. Railroad.

A report on the black-marble deposits of north Arkansas is being prepared by the Arkansas Geological Survey, and will soon be ready for distribution.

Limestone.—Generally speaking, there are two areas of lime-bearing rocks in Arkansas: (1) the Ozark Region of north Arkansas, and (2) a triangular section in the Gulf Coastal Plain of southwestern Arkansas in which rocks of Upper and Lower Cretaceous age are found. Almost no limestone is found in the Ouachita Province of western Arkansas, which includes Arkansas River Valley, Fourche Mountains, the Novaculite Uplift and the Athens Piedmont Plateau, although a few thin limestones occur in the Novaculite Uplift. Limestone beds (Tertiary) also occur in the western edge of the Coastal Plain beds at a few points. At the present time, however, no commercial use has been found for the lime lying outside the Ozark region

Fig. 7. Batesville White Lime Co. quarry at Ruddells, Izard County.

Fig. 8. Exposure of black marble in the Fayetteville shale, in Searcy County.

or the Cretaceous regions of southwestern Arkansas.

In northern Arkansas there are twenty different formations, ranging in age from the Pennsylvanian to the Lower Ordovician, carrying limestone beds. Generally speaking, these beds can be divided into two areas: (1) those in which the limestone is comparatively free from dolomite (containing about 2,700 sq. mi.) and (2) those in which the rock is predominantly dolomite (containing about 2,800 sq. mi.).

The Cretaceous area of southwestern Arkansas contains chalk and chalk marls of varying purity. The Annona chalk formation contains the highest quality chalk found in the state. The calcium-carbonate content of this material usually varies from

70 to 90 per cent. The Saratoga chalk is of lesser quality. The Arkadelphia marl, Marlbrook marl, and Brownstown marl contain limey clays. Two thin limestone-formation members present in this area are known as the De Queen limestone and the Dierks limestone. The total area of chalky or limey beds in this portion of Arkansas is about 700 sq. mi.

The three following lime-burning plants are now operating in northern Arkansas:

The Batesville White Lime Co., which has three kilns at Ruddells, Izard County, and six kilns and a hydrator at Limedale, Independence County, has a total capacity, in both lime-burning plants, of 141 tons per day of 24 hr. The Boone limestone supplies the raw material (Fig. 7). The plant at Ruddells is temporarily closed.

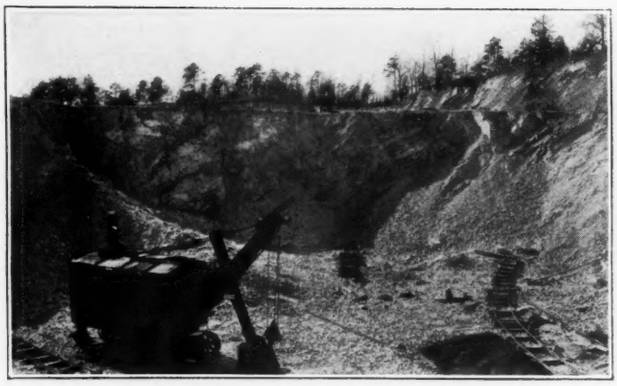


Fig. 9. Novaculite quarry near Butterfield, Hot Spring County.

The Ozark White Lime Co. plant at Johnson, Washington County, produces burned lime and hydrate and has a daily capacity of three car-loads. The quarry is in the Boone limestone formation.

The Arkansas Lime & Stone Co. plant at Mercer, Searcy Co., which produced both burned and hydrate lime and crushed limestone for agricultural purposes from the basal Boone limestone. The plant had a daily capacity of 125 bbl. of lime and 80 tons of agricultural limestone. This plant was practically destroyed by fire during the summer of 1931, and will probably be rebuilt early in 1932.

Cement.—During 1930 the Portland-cement plant

Fig. 12. Quarry of Silica Products Co., in Izard County.

at Okay, Howard County, operated by the Arkansas Portland Cement Co., produced cement by the wet process. This plant (Fig. 6) was completed in the fall of 1929. This company owns a 300-acre deposit of chalk with a thin overburden. Chalky limestone averaging about 85 per cent. calcium carbonate is secured from the Annona chalk formation (Upper Cretaceous age). The gypsum is obtained from Oklahoma. The capacity of this plant is between 2,500 and 3,000 bbl. daily.

This plant is equipped with a crusher, two Compeb mills and an Allis-Chalmers rotary kiln, steam-shovels, locomotives, conveyors, and other necessary machinery. The kiln is 11 ft. 6 in. in diameter and 300 ft. long and is heated by natural gas. The Compeb mills are driven by 800-hp. Allis-Chalmers motors. The plant has 12 concrete storage silos, each 30 ft. in diameter by 90 ft. high which, together with their 6 star bins, have a total capacity of 230,000 bbl. Chemical and physical testing laboratories are also maintained at this plant.

Another Portland-cement plant and also a lime-burning plant near Foreman, Little River County, with an estimated capacity of 600,000 bbl. per year, have been under construction by the American Portland Cement Co. for some time.

Oilstones.—Novaculite is distributed through

Fig. 10. A novaculite quarry.

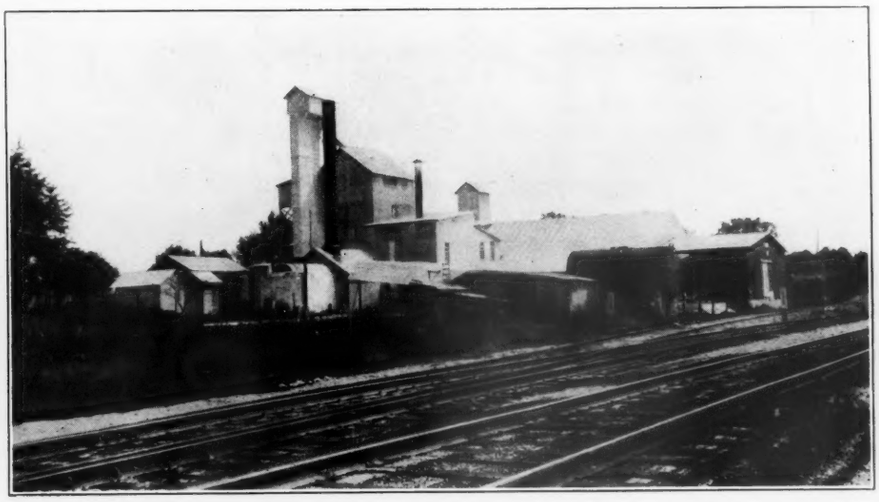


Fig. 11. Plant of Corona Silica, Inc., Rogers, Benton County.

west-central Arkansas and has been most actively quarried in Hot Spring (Fig. 9), Garland (Fig. 10), and Montgomery Counties. Two types of novaculite or oilstones are produced. These are the "soft" or Ouachita stone and the "hard" or Arkansas stone. The Pike Mfg. Co. of Hot Springs, ships both the Ouachita and Arkansas stone. The Garland Whetstone Co. of Hot Springs is operating one quarry near Hot Springs and ships the "hard" Arkansas stone.

Tripoli.—The only deposit of tripoli being worked at present is near Rogers (Fig. 11). This mine is being operated by the Corona Products, Inc., which has a wide market for its material. The plant is equipped with two pebble mills, washing and screening equipment, and has a capacity of 60 tons per day. Porous leached chert of the Boone formation averaging 99.5 per cent. silica is obtained from a deposit about 3½ mi. east of Rogers. This company now has about 2,500,000 tons of material blocked out. The deposit is from 10 to 80 ft. thick and has an overburden of from 3 to 40 ft.

Fig. 13. Test pit in barite deposit, Hot Spring County.

Chalk.—The Annona chalk is quarried by the Arkansas Lime Products Co., located at White Cliffs, Little River County, which markets agricultural lime, road ballast and whiting.

Glass Sand.—Two formations, the St. Peter and Calico Rock sandstones (Ordovician age), have wide distribution in north Arkansas. One plant (Fig. 12) is producing glass sand at Guion, Izard County. This has a 400-ton daily capacity and is operated by the Silica Products Co. Another plant will probably be built near Everton, Izard County, by D. D. Dunkin.

The glass-sand deposits of north Arkansas are now being used for glass and foundry sand only but, with cheap natural gas now available, it is possible that further utilization of the sandstone deposits will prove profitable. The Arkansas Geological Survey has recently published Bulletin 4, *The St. Peter and Older Ordovician Sandstones of Northern Arkansas,* by A. W. Giles.

Gypsum.—Gypsum occurs in the southwestern part of the state in Pike and Howard Counties in the De Queen limestone member of the upper Trinity formation of Lower Cretaceous age and is exposed in a narrow belt extending westward from Plaster Bluff on Little Missouri River, Pike County, into Oklahoma. The thickest exposure is at Plaster Bluff, Pike County, in Sec. 31, T. 8 S., R. 25 W., where the gypsum forms a single bed ranging from 10 to 14 ft. in thickness and is exposed for 450 ft. along the bluff. The overburden is about 65 ft. This bed consists of pure saccharoidal gypsum, although there are some thin seams of satin spar and as much as 3 ft. of interbedded clay in its lower part. The thickest layer of gypsum is 4 ft. thick and lies at the top. It is possible that the deposit at Plaster Bluff may be developed on a small scale in the future.

Barite.—The recent discovery of a deposit of bedded barite in Sec. 10, T. 3 S., R. 17 W., Hot Spring County, about 14 mi. east of Hot Springs, is of considerable interest. The thickness of the deposit at the point where openings have been made vary from 28 ft. to 46 ft. The material is minable by open-pit methods. Analyses made of samples show from 65 per cent. to 85 per cent. barium sulphate. The results of recent drill tests (Fig. 13) indicate that the deposit is of sufficient size to merit commercial development.

Fullers' Earth.—Fullers' earth in Arkansas is of two types, decomposed basaltic dike material and bentonite. The first type was mined near Olsen Switch, Saline County, from 1894 to 1919. The mining was by shaft and the decomposed basalt was crushed, dried, sifted and sacked. It has been used for bleaching animal and vegetable oils and fats.

Three deposits of bentonite having possible commercial value have been found in southern Arkansas. Two of these are in Saline County and one in Hot Spring County. One of the Saline County deposits, which is located in Sec. 13, T. 2 S., R. 13 W., covers at least one acre and varies in thickness from nothing to about 12 ft. The overburden varies from nothing to 10 ft. The second deposit is located about 12 mi. south of Little Rock and was found by the Root Refineries of El Dorado. No material, however, has yet been shipped from this deposit.

The Hot Spring County deposit as exposed in a road cut shows a thickness of 3 ft.

The three bentonite deposits referred to occur in the Wilcox formation of Tertiary age.

Soapstone.—A fairly good grade of soapstone has been known for many years to be located in Sec. 15, T. 1 N., R. 15 W., Saline County. New prospecting has recently been active and production may result.

THE December 30 issue of PIT AND QUARRY will carry another in this series of articles on the nonmetallic minerals of the various states, C. H. Richardson, professor of the department of mineralogy, Syracuse University, describing the geology and development of the resources of Vermont.

Diatomaceous Marl Found in Kansas May Launch Hydraulic-Lime Industry

Establishment of Domestic Production Would Free U. S. of Importing Material

RAW materials that appear from preliminary tests to be suitable for manufacture of hydraulic lime have recently been found in Kansas. Since the United States now imports this substance from Europe, the possibility of developing a good domestic source of hydraulic lime has considerable commercial importance, according to the State Geological Survey of Kansas. The Kansas deposits that may prove to be such sources are here called diatomaceous marl.

Three localities of diatomaceous marl in Wallace County, Kan., have been discovered and studied by M. K. Elias, of the Kansas Geological Survey. The largest one, on the Marshall ranch on the north fork of Smoky River, has been called chalk rock by local people and also has been supposed to be volcanic ash, since similar white powder-rock with abrasive or polishing qualities is widely distributed in western Kansas. A microscopic examination under high magnification (30 times or more) discloses the fact that this rock in Wallace County consists almost entirely of the siliceous tests of fresh-water diatoms and of flaky calcium carbonate.

Preliminary quantitative analysis of an average sample prepared from the upper 5 ft., comprising about half of the bed at the Marshall ranch, showed the dry rock with moisture expelled at about 105 deg. C. consists of about 81 per cent. of matter soluble in hydrochloric acid. This is chiefly, if not entirely, fine, flaky calcium carbonate. About 90 to 95 per cent. of the remaining insoluble part consists of siliceous tests of diatoms and of siliceous spicules of sponge. Fine to medium-grained quartz, with a slight mixture of feldspar, constitutes the remainder of the insoluble part. Due to the construction of the box-shaped empty tests of diatoms the percentage of the volume occupied by these tests is much greater than the percentage by weight. Roughly estimated, about one-half of the rock by volume is made up of diatoms.

Due to the large amount of calcium carbonate, it is appropriate to call the rock a diatomaceous marl instead of diatomaceous earth. Another reason for this term for the Marshall ranch rock lies in the different practical use which can possibly be made of diatomaceous marl compared with the pure or nearly-pure varieties of diatomaceous earth as obtained from southern California and other localities.

The diatomaceous earth which consists chiefly or entirely of the tests of diatoms is a highly-porous rock and is used now chiefly as a sound and heat insulator in building construction, as a filter for purifying drinking water, and in other cases where high porosity, neutrality to acids, or hardness and sharpness of the minute tests of diatoms are of advantage. The rock from the Marshall ranch might be regarded as a diatomaceous earth mixed with a large amount of flaky calcareous matter. It is softer and much less porous than ordinary diatomaceous earth and not at all neutral to acids. Thus, though the diatomaceous marl of Wallace County can probably be used in some cases where diatomaceous earth is now applied (for instance, as sound and heat insulators, as an abrasive, etc.), it is obviously an inferior material compared with the purer grades of the latter. On the other hand, the intimate mixture of the diatomaceous tests with calcium carbonate appears to have peculiar useful properties of its own which will decide its place and its value among other mineral resources of this country.

It was noticed in some limestones of Europe that, when the amount of silica and (to a much lesser extent) alumina and some other impurities in these rocks, is increased to about 12 per cent. or more, lime manufactured from them begins to acquire the property known as "hydraulicity," that is, it can harden or set under water. The natural cement which is made of these limestones is known as "hydraulic lime." Hydraulic lime is white and, in this and some other important respects, differs from the ordinary yellow or brown natural cements of the "Roman cement" type, which contain a much smaller amount of calcium carbonate and in which alumina and iron constitute a considerable part. A typical natural cement of this latter kind is manufactured at Fort Scott, Kan. The limestone from which the Fort Scott hydraulic cement is made contains: Silica 18.09 per cent., alumina 3.44 per cent., iron oxide 4.27 per cent., lime 35.32 per cent., and magnesia 4.62 per cent., average analysis (8).

The most famous and typical hydraulic lime is that known as Le Teil or La Farge, made from a limestone found in Ardèche, France. This limestone consists of calcium carbonate very intimately intermixed with finely-divided silica. It contains very little alumina and oxide of iron, which are the constituents generally necessary to bring about the union of silica and lime to form a cement, but in spite of this the silica is so finely divided and so well distributed that it unites readily with the lime when the limestone is burned at a sufficiently high temperature. When, subsequently, a little but proper amount of water is poured in, it slakes or disintegrates into fine powder and thus does not need to be ground, which is an unavoidable expense in the manufacture of ordinary cements of both the Portland and the natural cement (Roman) types.

As has been said, the Wallace County diatomaceous marl is a chalky substance with about 18 to 19 per cent. silica. It is composed chiefly of very fine tests of diatoms intimately mixed with flaky

calcium carbonate. There may be a trace of alumina. It remains to be seen if the two most important components of the Marshall ranch rock, calcium carbonate and silica, are fine enough and mixed intimately enough to produce a good natural hydraulic lime after being burned.

One hundred pounds of the diatomaceous marl from the Marshall ranch has been shipped by the Kansas Geological Survey to the United States Bureau of Standards, which agreed to make tests in order to find if the rock can be used for manufacture of hydraulic lime. The experiments of the Bureau of Standards are not completed, but preliminary study shows "from the work up to date it would appear that this material can be burned so as to produce a lime having hydraulic properties," according to a letter dated Dec. 29, 1930, from the Bureau of Standards.

ANALYSES OF LIMESTONES USED FOR HYDRAULIC LIME

	Le Teil, France		Senonches, France	Hansbergen, Germany
Silica (SiO_2)	12.40	16.80	17.00	11.03
Alumina (Al_2O_3)	0.60	0.81	1.00	3.75
Iron Oxide (Fe_2O_3)	0.50	trace	[1]	5.07
Lime (CaO)	47.49	45.40	44.80	43.02
Magnesia (MgO)	[1]	[1]	0.71	1.34
Carbon dioxide (CO_2)	37.31	35.67	35.99	35.27

[1]Not determined.

Hydraulic lime has some properties which make it different from Portland cement and from natural hydraulic cements. It sets more slowly than these cements but ultimately becomes as strong as Portland cement. The slow setting is an advantage for some special purposes, as for foundations and abutments where settling may occur. The structure is free to take its permanent position before the lime sets, and cracks are thus avoided. It is used, for instance, in place of Portland cement as grouting outside the cast-iron tubes used for lining tunnels made by the shield system. Being low in iron and soluble salts, hydraulic lime is light-colored and does not stain masonry, having thus a fair market for architectural uses in cities, especially in the east and southeast of the United States, where a considerable amount of this cement is now imported annually (8).

The available American or French literature lacks a precise description of the lithologic characters of the Le Teil marl, but the reported chemical constitution is almost identical to that of the Marshall ranch diatomaceous marl. The accompanying table, taken from Eckel (8), shows analyses of some European limestones from which hydraulic lime is manufactured.

The Marshall ranch diatomaceous marl is a freshwater deposit of Lower Pliocene age, while the siliceous marl of Le Teil constitutes the Criocera marls of the marine Lower Neocomian of the Cretaceous. The source of the finely-distributed silica in the beds from Le Teil is unknown. The possibility of the presence of diatoms in these rocks is not excluded, for the tests of these organisms are known in marine Cretaceous limestones of European Russia and California.

The Marshall ranch diatomaceous marl outcrops on the south side of the north fork of Smoky Hill River in Sec. 10, 11 and 12, T. 11 S., R. 38 W., Wallace County, and extends into Sec. 7, T. 11 S., R. 37 W., Logan County. The total length of the exposures, interrupted in places by loess, is slightly more than 3 mi. The thickness of the bed ranges from 2 or 3 ft. in the middle of Sec. 11 to 11 ft. in the eastern part of this section. The average thickness from here to the easternmost exposure in Logan County is about 7 ft. In the western half of Sec. 11 the diatomaceous marl is more limy and hard, but in the northwest quarter of Sec. 10 it is somewhat softer. On the top of the bed there is nearly always a thin hard ledge of white limestone, usually full of small cavities representing molds of fresh-water gastropods. This limestone is a few inches to 1 ft. thick. At the base of the diatomaceous marl there is generally a light-gray clay with some mixture of calcareous matter and diatoms, but locally there is greenish sand in place of clay at the base. A number of mammalian and other bones have been found in this sand.

The constitution of the diatomaceous marl is fairly uniform throughout. It is always a snow-white chalky rock, light and very fragile. However, it resists weathering and, together with the capping thin limestone, forms low cliffs and benches on the southern slope of Smoky River valley. In a few places erosion has formed of the diatomaceous marl separate cliffs which are scattered on the smooth, gently-descending slope of the valley. The rock is usually massive and is cut by widely-spaced vertical joints into large blocks. However, it has also a distinct horizontal stratification and can be broken with comparative ease along the closely-spaced bedding planes.

The overburden above the diatomaceous marl consists of the thin hard limestone and in some places of nearly 15 ft. of Ogallala grit, slightly cemented by calcium carbonate. Above this lies gravel and loess of Pleistocene age. The specific gravity of air-dry rock is about 1.53, which is approximately three times greater than that of pure diatomaceous earth from California.

Two other outcrops of diatomaceous marl in Wallace County have been studied. One that was shown to Elias by Jas. T. Madigan is in the SE. ¼ of SE. ¼ of Sec. 35, T. 11 S., R. 39 W., at the very head of one of the numerous draws on the south side of Lake Creek. The soft, snow-white diatomaceous marl, of apparently the same qualities as that of the Marshall ranch, makes here a small inconspicuous outcrop. The small size of the outcrop is probably due to the absence of the hard limestone at the top of the bed. The thickness of the outcropping rock is about 3 or 4 ft., but neither the base nor the top is visible. A few feet above the outcrop loess can be seen in the bluffs at the head of the canyon, while below and somewhat down the canyon a few outcrops of Ogallala grit can be observed.

The third locality of diatomaceous marl and the one in which the diatoms were first recognized by Elias in 1928 is in the NE. corner of NW. ¼ of Sec.

29, T. 12 S., R. 41 W., about one-half mile east of the Collins ranch. The diatomaceous marl of this locality is of somewhat different color and texture. It is light-gray in color and softer than the rock from Marshall ranch. There is probably less calcium carbonate and more diatoms and there is a mixture of clayey material in this rock. The bed is 4 ft. thick. It is slightly harder at the top and is capped by limestone partly silicified into compact, tough chert. The bed is underlain by greenish-gray clay. The lateral extent of the bed seems to be insignificant.

Soft, light-colored rocks in which diatoms constitute a considerable part are known in southwestern and western Nebraska (2, 3) and in Beaver County, Okla. (5, 6, 7), from which locality they probably extend into Meade and Seward Counties of southwestern Kansas. According to Adams (1) the soft chalky limestone, which he compares with the diatomaceous deposit of Beaver County, is exposed on both sides of Cimarron River in Seward County, Kan., and is there 10 ft. thick.

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Minimizing Pulverized-Coal Hazards

(*Continued on page 39*)

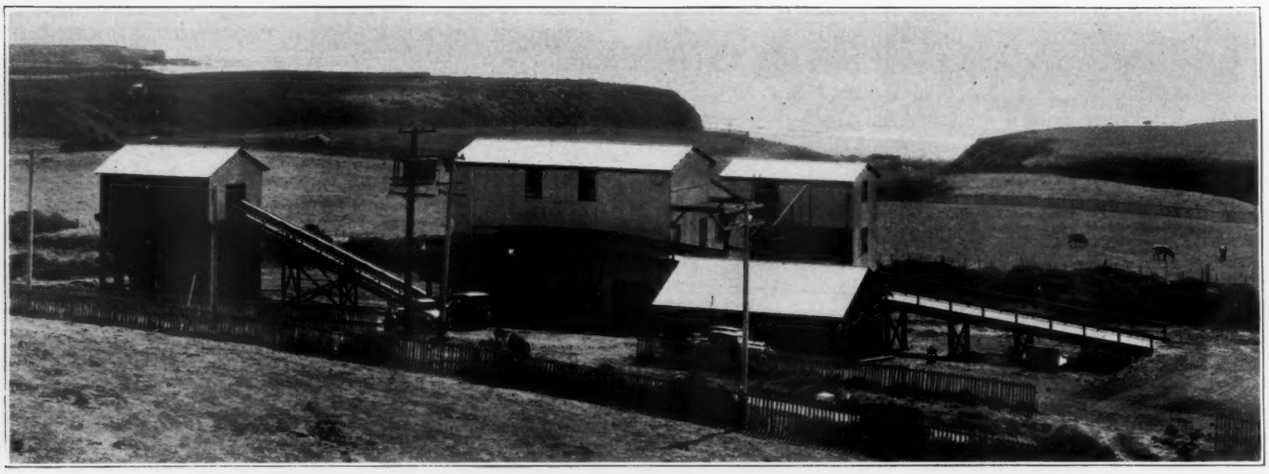
only after all dust has settled and after the circuit-breaker is knocked out.

In case of bin fires the following procedure is advised:

1. Cut off the coal supply to the storage bin.
2. Shut off the carrier air-supply to the bin.
3. Close the bin-vent damper. If the damper is automatic, make sure that it has properly closed.
3. Make sure that all other other openings into the bin, other than the feeders, are tight.
5. The foreman, fireman, or person in charge should be notified at once. It is this man's responsibility to exercise his judgment and determine whether the fire can be extinguished by its own fumes. If the fire has not gained headway and the bin has been tightly sealed, the fire will die because of lack of oxygen.
6. In some cases, where the fire has gained considerable headway, the vent damper may be damaged or the seams may have opened. It is important that every effort be made to close these openings with water soaked non-combustible material.
7. When all the bin openings have been tightly closed and the vents sealed, this will prevent the circulation of air and will create an atmosphere high in carbon dioxide. When all the available oxygen in the bunker has been exhausted, the fire in most cases will smother out.
8. Live steam or inert gases may be used to smother a fire if it gains headway. Steam and water should be used carefully, as it may create a dust cloud within the bin and thus set up an additional hazard of explosion. Water should not be used unless absolutely necessary. It has little value in putting out a fire in large quantities of pulverized coal and makes it practically impossible to use the feeders.
9. The bin should be emptied as quickly as possible, even while the fire is in progress, by feeding coal to the kiln. This emptying process should be carried on regardless of the difficulties experienced in the feeders due to lumps of coke.
10. If it is impossible to feed the coal to the furnace through the feeders, the bin should be sealed and the fire completely extinguished before the bin is opened.
11. Care must be exercised in opening a bin which has been sealed to extinguish a fire, so that any flammable gases which may have been generated during the time the bin was sealed will not be ignited when it is opened.
12. If all attempts to clear the feeders fail, men must enter the bin. In all cases, it should be thoroughly ventilated to eliminate any fumes and to make sure that the fire is really out. This work should be in charge of responsible men. Men entering the bin should be equipped with positive-pressure helmets or oxygen-breathing apparatus, and also with life-belts and life-lines. Life-lines should be in charge of a second worker outside the bin, and the man inside should be watched at all times.
13. In some cases it will not be necessary to empty the bin after a fire but, when doing so, coal should never be discharged on the floor through the opening in the bottom. It should be removed either by disconnecting the feed-pipe and discharging into buckets, or by bucketing the coal cut through the top manhole. Fire of bulk coal in other equipment may be fought by the same measures.

Even though the coal-pulverizing system is efficiently designed and the most effective safety devices are provided, much of the value of these safeguards is lost if plant operatives are not educated to note and avoid potential dangers. Several of the incidents mentioned illustrate this fact: for example, the accident caused by the lighting of a torch in the elevator of a crushing plant and that caused by a fireman neglecting a drier furnace until hot coal was carried from the drier to the pulverizer.

It is of the utmost importance that the men in the plant, and also those who are in and around kilns which are using pulverized coal, should be impressed with the idea that coal dust is explosive and inflammable when in a cloud and mixed with the proper amount of air, and that it should be treated just as carefully as natural gas.



The plant as seen from a hillside across the road. The bluffs in the background overlook the blue Pacific.

California Plant Produces Rock Asphalt for Cold-Mixed Highway Paving

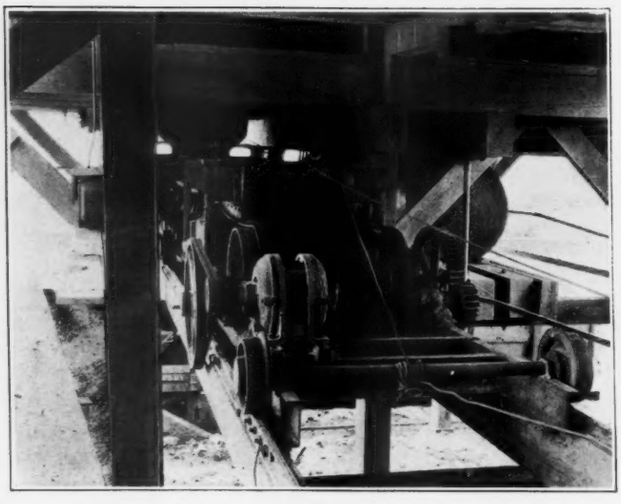
By J. E. HAYES

Manager and Chief Engineer, Calrock Asphalt Co.

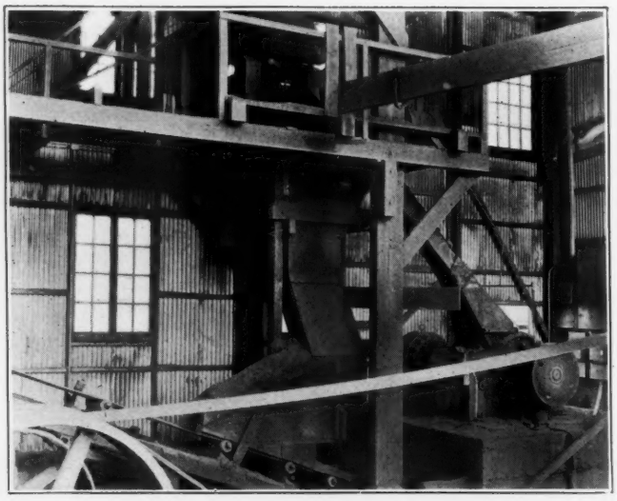
THE first modern plant on the Pacific Coast for the production of rock asphalt for cold-paving purposes is being operated by the Calrock Asphalt Co. on a branch of the Southern Pacific Ry., about 5 mi. northwest of Santa Cruz, Cal. The plant was completed in October 1930, and has now been in operation for slightly more than one year. Previous to that time an old mill had been operated for a number of years 1 mi. east of the present location.

The material as quarried is a bituminous sandstone in which the matrix is a hard native bitumen having a penetration of 8 to 20. The percentage of bitumen varies from 14 to about 7 by weight. The aggregate is a nearly pure silica sand, a typical grading of which is as follows:

Passing 10-mesh .....100 per cent.
Passing 40-mesh ..... 55 per cent.



Drive and feed mechanism of car-loading conveyor.



Vibrating screen above, hammer-mill at right and conveyor to loading building below.

Passing 80-mesh ..... 25 per cent.
Passing 200-mesh ..... 3 per cent.

The deposits occur in approximately horizontal strata, varying from thin laminations to beds 50 ft. or more in thickness. The prevailing dip is about 10 deg. toward the ocean. Major step faults along lines parallel to the ocean shore give the surface a terraced appearance. The exposed edges of the ledges at these faults afford good sites for the opening of quarries.

The overburden consists chiefly of surface soil and diatomaceous shale with occasional sand, gravel and sandstone. The overburden is drilled and blasted, and removed by means of a power shovel and dump trucks to a waste pile. So far, this stripping has been carried out by contract, on the basis of bank volume.

The bituminous sandstone is drilled with jack-hammers. The usual cross bit is used, with the water opening at the side instead of at the bottom of the bit. The rock is easily and rapidly drilled. Vertical holes only are used, and the maximum depth is about 15 ft.

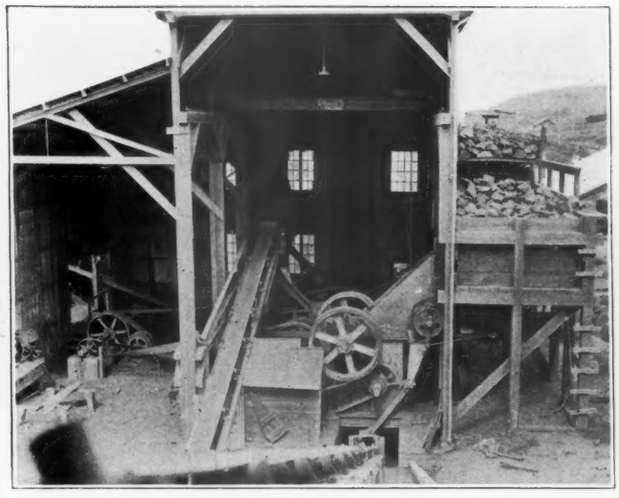
Holes are sprung with 40-per cent. nitro-glycerine, and then loaded with black powder. Due to the tenacious and somewhat rubbery character of the rock, a slow explosive is the most effective.

The rock does not shatter well, and considerable breaking remains to be done after the blasting. The larger pieces are block-holed, after which the rock is reduced to one-man size by hand sledging and wedging. It is loaded by hand into 1 cu. yd. dump cars, which are emptied into dump trucks for hauling to the crushing plant.

A comprehensive program of core drilling has been undertaken and is being carried on continuously. This drilling will eventually cover the entire properties of the company, amounting to over 600 acres.

Loading a truck in one of the quarries.

The drilling rig is operated by one man, except while moving, when a helper is supplied. The total cost per foot of hole has been approximately 86 c., and the investment in drilling equipment, including gasoline-driven pump and 900 ft. of water-pipe, is only $348.39. In view of these costs, it is believed that a brief description of the rig will be of interest.

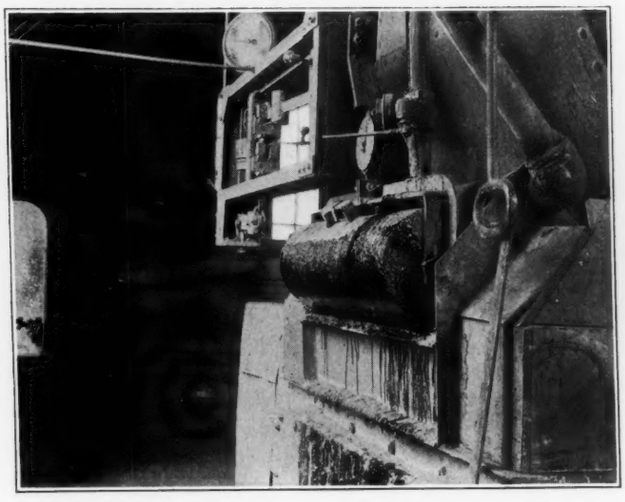


Interior of plant viewed from storage building. Truck discharging to hopper at right.

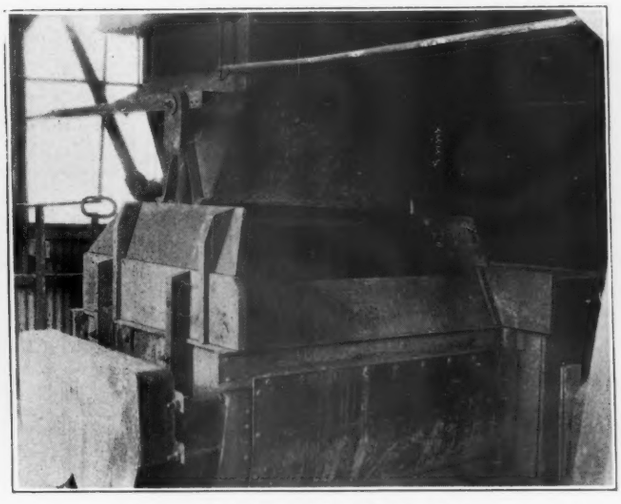
A Sullivan single-tube size B core barrel is used, with 80 ft. of size E drill rods and standard water swivel. The cutting bits are set with Haynes Stellite teeth, 6 teeth to the bit, welded on and the spaces between the teeth filled with cast bronze.

The drill rod is driven at about 150 r.p.m. by a gasoline garden tractor and single-rope drive. The details of this drive are shown in one of the illustrations. Weight is applied to the bit by means of a cross-arm on which are hung weights, regulated to obtain the desired cutting speed. A gasoline-driven pump supplies water under adequate pressure.

The site of the crushing plant is centrally located with reference to the large deposits of bituminous sandstone that extend for several miles back from the Pacific Ocean at this point. In fact, the quarry most extensively operated at present is only about 200 yd. from the plant. As can be seen from the illustrations, the ground on which the plant is built is sloping and substantially higher than the level of the spur track.

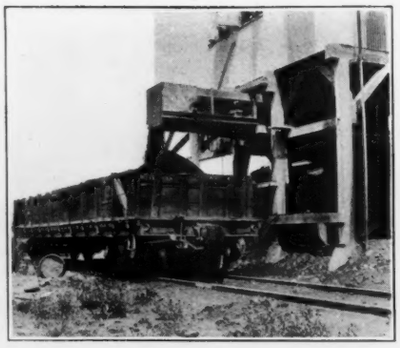


Weighing batcher with scale and oil-feed equipment.

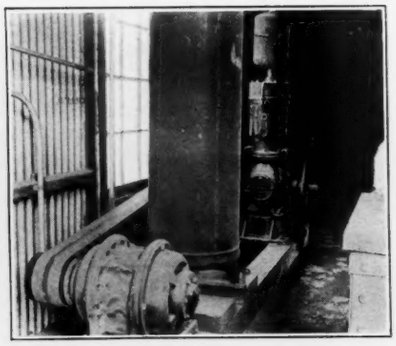


Pug-mill with weighing batcher above.

Core-drilling the deposit.



Shuttle conveyor loading car.



Air-compressor and tank.

There are three distinct building units to the crushing plant: (1) The crushing building, which contains the crushing and screening machinery; (2) a 200-ton storage bin; and (3) the mixing building in which the pulverized rock asphalt is mixed with certain other ingredients and from which it is discharged into the railroad cars or trucks for shipment.

The rock asphalt is transported from the quarries in 5-cu.-yd. dump trucks, which are backed up a ramp and dumped into a 15-ton timber hopper at the plant. A 36-in. pan-feeder puts the rock into the 18-in. by 32-in. primary crusher, the flow being controlled by heavy cast-iron swing-hammers.

The primary crusher was specially designed and is of the roll-jaw type, in which a curved jaw operates against a large-diameter roll. The upper end of the jaw frame is mounted on an eccentric shaft, while the lower end operates against an inclined toggle. As the jaw approaches the roll it also moves downward, tending to rotate the roll and facilitate the discharge of the crushed material. In tests made preliminary to the design of the plant, it was found that jaw crushers of the standard types did not crush the rock asphalt satisfactorily, due to the slight stickiness of the material and the resulting hanging up and clogging in the crushers.

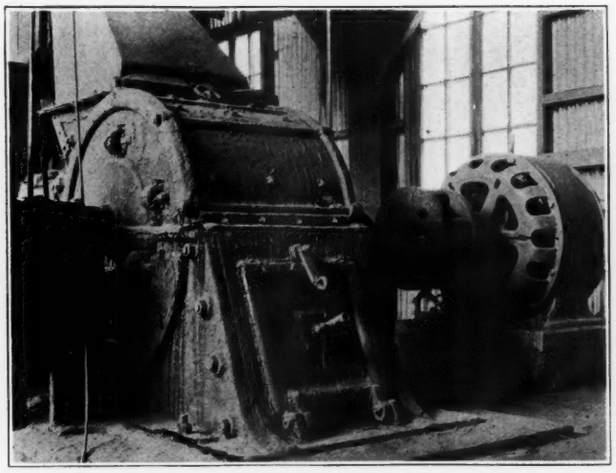
The roll-jaw crusher reduces to 3-in. size and under and discharges on inclined belt-conveyor No. 1 which extends over and empties into the 200-ton storage bin. This bin is kept well filled to facilitate prompt execution of orders.

After leaving the storage bin, the flow of material is continuous until it is finally discharged into the railroad car or waiting truck for shipment. A 24-in. pan-feeder with swing-hammer control at the bottom of the bin supplies a uniform stream to belt-conveyor No. 2 which carries it back into the crushing building and discharges it into the secondary crushing unit, 43-in. by 16-in. Garfield-type rolls. This conveyor is horizontal under the bins and inclines to the crushing plant.

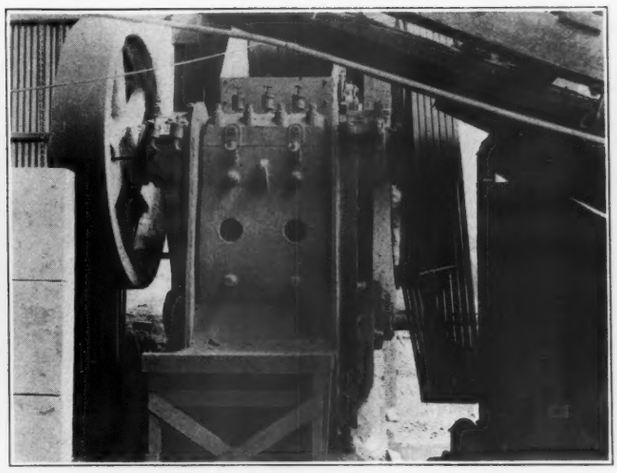
The product of the rolls, about 2 in. in maximum size, passes into a pit and to another belt-conveyor

TABULAR ANALYSIS OF THE OPERATIONS AND EQUIPMENT OF THE CALROCK ASPHALT CO., SANTA CRUZ, CAL.

Operation	Key	Equipment	Make	Model No., Size, Capacity or Type	Power Source	Power Transmission
Stripping	1	Dump truck	F. W. D.	5-ton		
Drilling	2	Drills	Ingersoll-Rand	Type 5-49 wet Jackhamers	Air	
Transportation	3	Dump truck	F. W. D.	5-ton		
	4	Hopper		15-ton		
	5	Feeder	Stephens-Adamson	36-in. pan	Crusher drive-shaft	Chain
Primary crushing	6	Crusher	Joshua Hendy	18-in. by 32-in. roll-jaw type	50-hp. Fairbanks-Morse	Dayton Cog-Belt
	7	Belt-conveyor	Stephens-Adamson	18-in.	3-hp. Allis-Chalmers	Belt and gear
Storage	8	Bin		200-ton		
	9	Feeder	Stephens-Adamson	24-in. pan	Conveyor tail-pulley	Chain
	10	Belt-conveyor	Stephens-Adamson	18-in.	5-hp. Allis-Chalmers	Belt and gear
Secondary Crushing	11	Crusher	Allis-Chalmers	43-in. by 16-in. Garfield rolls	75-hp. Allis-Chalmers	Dayton Cog-Belt and belt
	12	Belt-conveyor	Stephens-Adamson	18-in.	3-hp. Allis-Chalmers	Belt and gear
	13	Belt-conveyor	Stephens-Adamson	18-in.	3-hp. Allis-Chalmers	Belt and gear
	14	Belt-conveyor	Stephens-Adamson	18-in.	3-hp. Allis-Chalmers	Belt and gear
Screening	15	Vibrating screen	Robins	42-in. by 60-in. single-deck Vibrex		
	16	Belt-conveyor	Stephens-Adamson	18-in.	3-hp. Allis-Chalmers	Belt and gear
	17	Hopper		3-ton		
Weighing, Mixing and Loading	18	Weigh hopper		2-ton		
	19	Pug-mill	Geiger Iron Wks.	3,000-lb.	75-hp. Allis Chalmers	Dayton Cog-Belt and gear
	20	Loading conveyor	Stephens-Adamson	Shuttle-type 30-in.	3-hp. Allis-Chalmers	Dayton Cog-Belt
Recrushing of screen oversize	15a	Hammer-mill	Williams	Swing-hammer	40-hp. Westinghouse	Direct
Miscellaneous	21	Air-compressor	Rix Compressed Air &. Drill Co.	1-cyl. vertical	1½-hp. G. E. motor	Belt
	22	Steam winch			Compressed air	
	23	Crane	Cyclops Iron Wks.	Overhead traveling	Manual	Chain
	24	Oil-storage tank		12,500-gal.		
	25	Oil-feed tank		500-gal.		



The hammer-mill used for final reduction of oversize material.



A close-up end view of the roll-jaw primary crusher and drive.

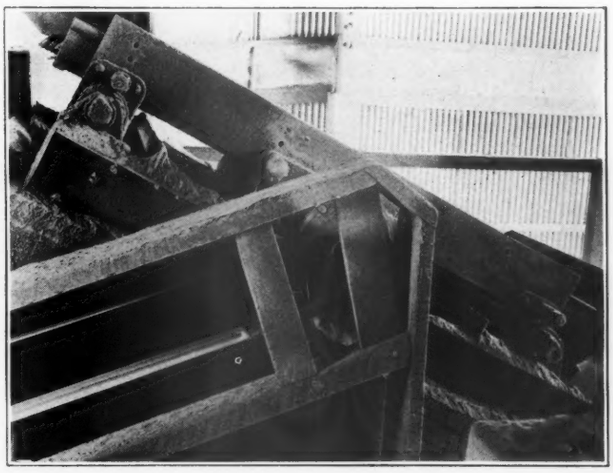
No. 3, which carries it out of the crusher building to a cross conveyor No. 4, and then to a third conveyor No. 5, which extends back into the upper part of the crushing building and discharges on a 42-in. by 60-in. vibrating screen with ⅜-in.-mesh wire cloth.

The material passing the screen, ranging from ⅜ in. to dust, flows to belt-conveyor No. 6, which carries it to the top of the mixing building. The oversize material is discharged into a swing-hammer mill from which it passes into the pit, joins the stream from the secondary crushing rolls, and passes again over the vibrating screen. The screen is thus in closed-circuit, and none but screened material goes to the mixing building.

The belt-conveyor carrying the screened material into the mixing building discharges into a steel surge hopper of 3-ton capacity with a hand-operated bottom gate. This hopper empties into a 2-ton steel weigh-hopper of the type used in asphalt plants. This is fitted with a Fairbanks beam scale. The weigh-hopper discharges into a 1½-ton twin-shaft pug-mill.

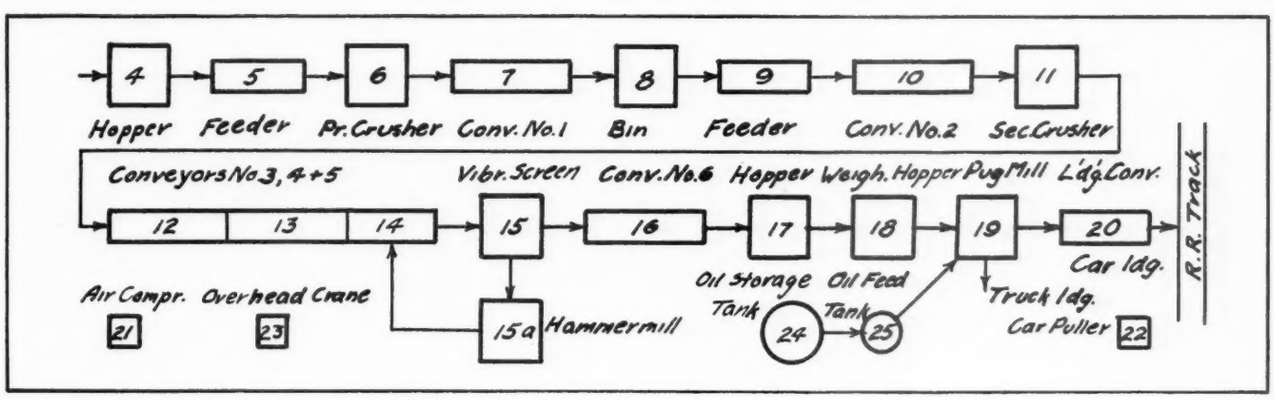
Fluxing oil, mineral filler and other ingredients are weighed on separate scales and are here mixed cold with the rock asphalt to form a cold-paving material of predetermined and accurately-controlled characteristics.

Beneath the pug-mill is a 30-in. shuttle belt-conveyor mounted on a traveling carriage. When railroad cars are being loaded, this conveyor is projected out over the spur track. While cars are being "spotted," and when loading into trucks, the conveyor is withdrawn. A driveway passes directly under the pug-mill for truck loading.



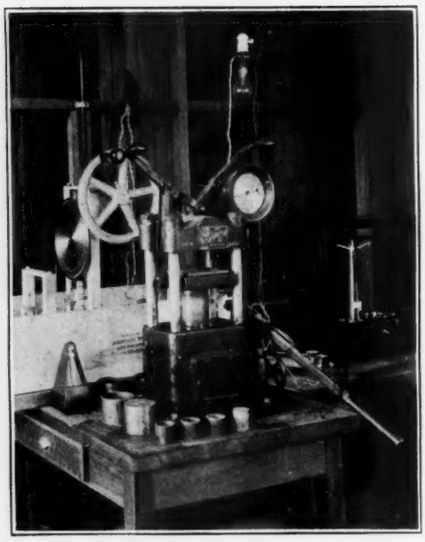
The single-deck vibrating screen used for final sizing.

Fluxing oil is obtained in tank cars and stored in a 12,500-gal. steel tank. A 500-gal. surge tank is located on the top floor of the mixing building, and is automatically kept filled by means of a float switch and a motor-driven pump. From the surge tank the



Flow-sheet of operations, Calrock Asphalt Co. plant.

The testing laboratory. Constant-temperature drying oven at the left, and some of the other apparatus.



Hydraulic press, shear machine and laboratory scales.

oil flows by gravity to the weighing bucket located just above the pug-mill.

As the cars are loaded, they are advanced along the spur track by means of a 2-cylinder steam winch operated by compressed air. The operating valve is conveniently located on the pug-mill floor, so that the man who operates the pug-mill can also advance the cars as required.

The entire plant is electrically-driven, a separate motor, in general, being provided for each unit. The 24-in. pan-feeder at the bottom of the secondary storage bin, all conveyors between that point and the pug-mill, and the vibrating screen are operated by a single magnetic switch with dual push-button control on the mixing floor and on the floor of the crusher building. Thus the pug-mill operator can instantly start or stop the entire stream of material passing through the plant.

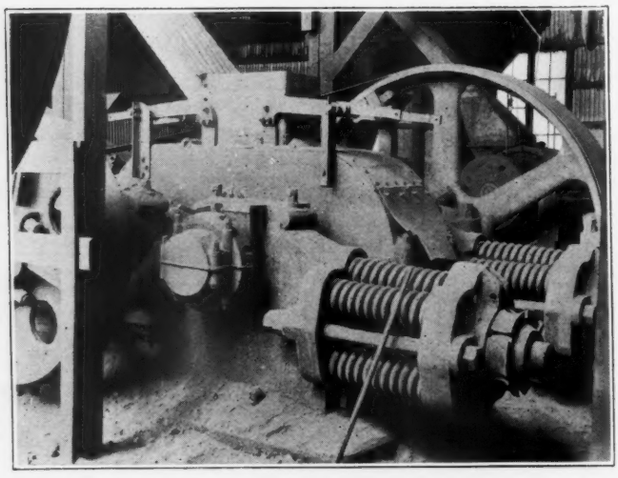
The three principal crushing units are placed in a row along one side of the crusher building, and are served by a hand-operated traveling crane for convenience in handling the heavy parts. Pioneer conveyor and drive belts and Crouse-Hinds conduit are used throughout the plant. All the buildings are inclosed with Cop-R-Loy corrugated sheet metal.

The plant is operated by two men; one to watch the machinery, and the other to operate the pug-mill. Apart from the mixing, the operation of the entire plant is automatic.

The capacity of the plant is about 250 tons of mixed paving material per 8-hr. shift. When running at full capacity, the cleaning up, of which there is considerable, must be done outside operating time.

A separate building contains the office, laboratory, store-room and wash-room. The laboratory is fully equipped with the best modern apparatus for testing asphalts and paving materials. The plant chemist, who is also the superintendent, devotes the largest part of his time to the laboratory, testing each shipment, making analyses of quarry samples, and developing new uses and processes for the material.

The personnel of the company includes: President, Maxwell C. Milton; manager and chief engineer, J. E. Hayes; consulting engineer on plant design, J. D. Rieser; chemist and plant superintendent, R. A. Harker.



The roll-crusher used for secondary reduction.

New Arizona Lime Plant

(*Continued from page 22*)

dagnoli, an expert lime burner who learned his trade in Italy and has designed numerous plants in this country. In this vicinity alone he has designed plants in El Paso, Tex., as well as the ones at Globe and Tucson. He is at present in charge of operations at the Globe plant, while his son, Nick Guadagnoli, is in charge of the Tucson plant.

Frank R. Rendon, president of the company, was born and raised in Tucson. Starting in the cattle business, he opened a motor-bus line between Tucson and Nogales in 1917. In 1925 he sold his holdings to the Pickwick Stages and later became interested in the lime industry.

Abstracts of Papers Read at the Zurich Congress on Testing Materials

Views of World's Scientists on Stone and Nonmetallic Minerals in General

AT the recent meeting in Zurich, Switzerland, of the First International Congress of the New International Assn. for Testing Materials a number of valuable papers dealing with subjects of interest to nonmetallic-mineral producers were read in the B Section of the meeting. This section interested itself in three classes of subjects: (1) Stone and general discussion of nonmetallic minerals; (2) cement; and (3) concrete. Several of the papers read in Divisions 2 and 3 above have already been published in full in PIT AND QUARRY; others will appear from time to time.

Herewith are presented abstracts of the papers dealing with the subjects in Division 1. These are accompanied, in some cases, by brief biographical notices concerning the authors. A review of the papers delivered in Division 2, dealing with cement, will appear in a later issue of PIT AND QUARRY and these will be followed by a review of the papers read in the concrete division. In some cases the complete papers will be published as well as the abstracts, although not necessarily in the same issue.

Dr. Roman Grengg.

Dr. Roman Grengg, professor at the Vienna Technical College and director of the Institute of Mineralogy and Building Materials, consulting engineer in chemical technology, was born Dec. 1, 1884, at Stein on the Danube, Austria. He was educated at the Technical College and at the University in Vienna, and on completion of his studies was employed as assistant at the Technical College and as professor and material-testing engineer at the Museum of Technology and Industry in Vienna. His scientific studies were at first concerned with problems of mineralogical chemistry and later with questions of practical geology and mineralogy. The Austrian works of standardization have given him ample sphere for the correlation of mineralogy and the scientific study of building materials, and in recent years he has published many works dealing with the evaluation of natural stones for construction purposes. At present he and his co-workers at the Vienna Technical College are carrying out investigations on the meteorological stability of stone and methods for its preservation.

PROF. DR.-ING. ROMAN GRENGG, director of the Institute of Mineralogy and Building Materials at the Vienna Technical College, Vienna, Austria: *Application of Mineralogical and Petrographical Data to the Testing of Nonmetallic-Mineral Substances.*

THE testing method which combines mineralogy, petrography and geology rarely makes it possible to arrive at mathematical values such as those of the customary physical tests; its importance lies essentially in the fact that it assists in making a proper selection of materials and proper conduct of the testing methods; furthermore, it furnishes a means for correctly utilizing the test results. The nonmetallic-mineral substances principally concerned in this report are the natural stones and earths and, among manufactured products, glass, ceramic products, and cementing materials.

A practical application of the geological method of investigation consists first in treating the test specimen as a portion of a larger whole (stone formations, deposits, etc.). An inquiry into the formation and a suitable selection of a test specimen must, therefore, form the bases for proper investigation of natural substances and the conduct of the research work. Mineralogical methods proper are concerned with the determination of the various chemico-mineralogical forms and properties of the material under test: grain size, shape, quantitative proportions, stability, and combinations. Hence, the methods should characterize constituents and structure in such a way that the behavior of the whole material under various physical stresses or chemical actions can either be interpreted or predicted. The report deals briefly with macroscopical and microscopical mineralogical methods and the evaluation of their results.

The development of micro-chemistry, of microscopy by vertical illumination, and particularly the X-ray technique, have greatly widened the field of technico-mineralogical investigation. In recent years it has been extended still further by progress in geophysics and various specialized branches of physics and chemistry, and particularly by the work of research laboratories serving as intermediaries between pure science and practice. It is for modern mineralogical technicians to put the information thus acquired to every-day use. The report gives examples which point to the importance of recasting pure mineralogical and testing methods in the light of other branches of science.

PROF. DR. P. NIGGLI AND DR. F. DE QUERVAIN, Gectechnic Commission of the Swiss Natural Science Society: *Application of Mineralogic-Petrographic Data to the Testing of Nonmetallic Inorganic Materials.*

IN the testing of nonmetallic inorganic materials the mineralogist and petrographer has frequent-

ly played the role of consultant, responsible only for determining that the stone has been correctly designated. Since a number of testing requirements based on mineralogy have come into the specifications—such as resistance to grinding wear, under certain circumstances resistance to fracture, and the like—he also has become the collaborator of the engineer in determining these properties. Such requirements are increasing and are being clarified, and there are three main fields in which further collaboration of the mineralogist with the engineer is required. As geologist, he should supply information on the properties and the occurrence of useful stones and minerals, their local distribution, and the constancy or variation of formation, etc. As crystallographer he must assist in the scientific testing of properties, principally in the solution of problems connected with the anisotrop of the individual components or anisotropy of the whole rock. As descriptive natural scientist he is charged especially with the problem of determining the properties of structure in such a way that the methods of investigation can be applied in the shortest and most economical manner. It would be one of the most important results of the Congress if any stimulus were given to the establishment of agencies prepared to carry out such work.

JEAN-FERNAND CELLERIER, director of the testing laboratory of the Conservatoire National des Arts et Metiers, Paris: *Investigation of Means of Preservation of Natural Stones.*

ALTHOUGH structures and monuments of natural stone have come down to us from great antiquity in good state of preservation, many such structures of more recent age are very susceptible to disintegration, particularly in and near cities where they are attacked by chemical agents liberated from manufacturing processes, etc. Sulphuric acid, in particular, resulting from the combustion of coal and coke, attacks these stones, and to a certain extent nitric acid, although the efflorescences commonly attributed to this acid actually contain little nitrate. Of methods of preservation now in use the physical methods depend on the application of encaustics, such as paraffines dissolved in various organic solvents; and chemical processes consist in the application of substances (silicates, barytes, fluates) which will form an impermeable surface in combination with the exposed stone surface.

All these methods have the disadvantages of comparatively frequent need for renewal and the difficulty of applying them to high facades and similar places difficult of access; also, frequently the impermeable surface prevents the escape of moisture in the stone and thus leads to internal disintegration. The author proposes methods of test, submitting surfaces of test specimens to various chemical actions, and urges the importance of such tests for developing a really satisfactory method of preservation.

Jean-Fernand Cellerier.

Prof. G. Berg.

Jean-Fernand Cellerier, director of the testing laboratory of the Conservatoire National des Arts et Metiers at Paris, was born May 28, 1870, at Bordeaux, France. Besides his work at the Conservatoire National he holds offices and memberships in many of the Scientific societies of France: the Bureau of Weights and Measures; vice-president of the French Committee of Lighting and Heating; vice-president of the French Assn. for Testing Materials; president of the Permanent International Bureau of Masonry, Reinforced Concrete and Heavy Construction; vice-president of the French Society of Electricians; scientific consultant of the French Society of Architects; sectional president of the International Congress of Electricity of 1932; director of the Laboratory of Scientific Researches of the Louvre Museum.

PROF. H. BURCHARTZ, Staatliche Materialprüfungsamt (State Material-Testing Bureau) Berlin-Dahlem, Berlin, Germany: *Procedures for Testing Road Stone and Ballast for Resistance to Static and Dynamic Stresses.*

BOTH road stone and railway ballast are subjected in service, aside from such influences as weathering, to more or less heavy static and dynamic mechanical stresses, and resistance of a given stone to these stresses is of high importance for the preservation of the road-bed. Only a thorough investigation can show what tests are more comprehensive and accurate for judging these properties, and in this report many of the tests used in Germany and elsewhere are examined. Those particularly recommended are:

(1) Testing the compressive strength of the stone substance, using a cubic test specimen. This test is always necessary if a stone is being used for the first time; otherwise it can be omitted if the other tests are carried out.

(2) Testing the resistance of the stone to a compression in the form in which it is used—that is, as crushed stone. The procedure of the Staatliche 3-Materialprüfungamt Berlin-Dahlem is to put a 3-kg. charge of dry stone of 3.5-cm. to 6-cm. grading in a steel cylinder and submit it to the pressure of a piston under gradually increasing pressure up to 40 tons. The index of the test is the amount of "fines" resulting from subsequent screening.

(3) Testing the resistance of the stone substance to impact. The Föppel procedure, standardized in Germany, is to drop a ram of 50 kg. on a 4-cm.

(*Continued on page 58*)

Maintaining Health and Promoting Safety Through Physical Examinations

By JOHN PRINCE
President, Stewart Sand and Material Co.

EARLY in 1930 the Stewart Sand & Material Co. of Kansas City took over the operation of a number of crushed-stone plants previously operated by another company. As our predecessors had for some time been self-insurers under the Compensation Act in Missouri and Kansas, we continued the operation of the crushed-stone plants under the same plan, but did not at that time extend self-insurance to cover our other operations.

As most of these quarries had been operated by hand loading, our predecessors had a rather large group of employees. For 1929 this involved about 800,000 man-hr. worked resulting in about 90 lost-time accidents at a substantial cost for compensation. For 1930 the number of plants operated was considerably reduced and the improvements introduced cut the amount of labor materially, reducing the man-hr. worked in crushed-stone plants to 418,557.

Organized safety work, begun in 1930, resulted in a marked reduction in lost-time accidents from 90 in 1929 to 15 in 1930. Considering the number of man-hr. worked, the reduction amounted to about one-third of the number of accidents occurring in the previous year. While this result was a marked improvement, it was not in itself particularly satisfactory, as the frequency rate of 35.8 seemed still unnecessarily high. From the point of view of the company and the money cost of accidents, the self-insurance plan showed a net profit for the year 1930 of $7,788. This profit was shown by crediting the account at the regular manual rates and charging the cost of administration and taxes amounting to $4,100 in addition to the direct cost of accidents.

Beginning with 1931, the company carried as a self-insurer the compensation risk on all employees, but for 1931 re-insured itself under an excess-loss policy. This policy protects the company against losses in any one year in excess of the manual rate, for which the company pays a premium of 10 per cent. of the manual rate.

Due to general conditions, the number of employees of the company has been still further reduced but, in spite of the continuation of the same overhead charge against the self-insurance account and the cost of reïnsurance, the account will show a profit, with a further reduction in the number of lost-time accidents to a present total of five for the year.

Some months ago one of our quarry workmen developed a case of hernia which required hospitalization and compensation for about two months. While this was not the result of any accident or injury received while in the employ of the company, it became a compensation case, chargeable against our self-insurance account. Growing out of this incident in part, it was determined that the company would attempt a plan of having all employees examined physically by a competent physician. The subject was discussed with Dr. W. H. Hines, who has a large industrial practice in Kansas City, and the program decided upon. The result of the original examinations, involving 191 employees operating at several plants and yards of the company, is shown on the accompanying schedule.

THE data herein presented were sent by the author to the National Sand & Gravel Assn. in answer to its request for further information on one of the three main topics of his talk before the National Safety Congress (see Pit and Quarry, Nov. 4, 1931, p. 49-50).

This schedule shows further the result of the examination of 67 subsequent applicants for employment by the company. While the total number of examinations is not large and it is doubtful how valuable conclusions may be when based on a total of 231 examinations, still the results were somewhat astonishing to the company. Due to the general conditions and the decline in the number employed during the past two years, all the original 191 workers examined were relatively permanent employees of the company, most of them having been employed for several years. It was surprising, therefore, to find 32, or about 17 per cent., suffering from major defects, which created a serious accident hazard to both the employee and the company; and, further, we were astonished to find two-thirds of the defects to be serious cases of hernia.

Among the 67 applicants examined subsequently, 16, or 24 per cent., were rejected because of serious defects. In both groups, hernia was very evident with heart defects making up a large percentage of the balance.

A serious effort was made to correct the defects of those found physically unfit, in order that they could continue their employment. We were fortunate to be able either to relocate or to correct about two-thirds of those of the original group found with major defects. Even then it became necessary in the interests of both the company and the men to dismiss 11 of the original group. It was found possible to correct the defects of nearly half of the original group, which should contribute greatly to the useful life and happiness of these men.

In undertaking this plan of physical examination, we generally had the support of superintendents and foremen, who readily saw the importance of this, both to the men and to the company. Apparently no real objections or resentment developed among the men except in a few cases where they were undoubtedly aware of their own defects and

feared to face the test of a physical examination.

Now that the plan of physical examination has been undertaken, the benefits are so apparent and the cost so relatively low that I doubt if the company will again operate without it. On a purely money basis, the accident hazard which may result in substantial medical and compensation costs of the defective group is so great that for this reason alone it should be continued. I believe the physical examination is equally important to the employees, as undoubtedly the number of disclosed major defects which can be corrected justifies the plan from the purely social point of view. Even the limited experience indicated by this report suggests, however, the general social problem being created by those who can not pass the physical examination. With the almost-universal advent of compensation-insurance laws in this country, with the increasing number of self-insurers, and the increasing practice of requiring a physical examination, it is easy to see that society has a real problem in providing for those who are suffering from major defects that disqualify them for the work to which they are accustomed.

All employees engaged in operating departments were given a physical examination at the beginning of operations in the spring of this year. Hernia, heart impairment, vision (in some cases), and social disease were regarded as potential industrial hazards of major importance. All subsequent applicants were required to pass the same tests.

RESULTS OF PHYSICAL EXAMINATIONS OF EMPLOYEES AT THE STEWART SAND & MATERIAL CO., 1931

Gross Results

Number of cases examined		258
Number of cases approved		231
Number of cases rejected		27
Causes for rejection—		
Hernia	16	
Heart impairment	8	
Vision	2	
Stiff elbow	1	

Original Employees

Number of employees examined		191
Number of employees found O.K.		89
Number of employees with minor defects		38
Number of employees with major defects		32
Nature of minor defects—		
Partial deafness	4	
Vision impaired	7	
Fingers (stiff, deformed, or missing)	14	
Varicocele	4	
Hydrocele	2	
Slight umbilical hernia	6	
Deformity of collar-bone	1	
Nature of major defects—		
Hernia	22	
Heart	8	
Social disease	2	
Disposition of major defects—		
Corrected by operation	5	
Assigned to different work	6	
Partial correction (older employees, such as yard clerks, foremen and weigh master, permitted to wear trusses)	10	
Discharged for refusal to correct defect, or for other reasons	11	

Subsequent Applicants

Number of applicants examined		67
Number of applicants found O.K.		44
Number of applicants with minor defects		7
Number of applicants rejected		16
Nature of minor defects—		
Vision impairment	2	
Eye artificial	1	
Partial loss of hearing	1	
Varicocele	1	
Fingers (lost or impaired)	2	
Cause for rejection—		
Heart	6	
Hernia	6	
Vision	2	
Color blindness (truck driver)	1	
Stiff elbow	1	

Abstracts of Zurich Papers

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cubic specimen, increasing the height of fall until the specimen breaks.

(4) Testing the resistance of the stone, in the form in which it is used, to impact. In the method of the Staatliche Materialprüfungsamt 3 kg. of air-dry stone of 30 to 60-mm. grading is first submitted to the 40-ton pressure in cylinder used in Test 2, then is given fifty blows from a 50-cm. height with the ram used in the Föppel test, then screened on the 10-mm. screen. The loss of weight gives a measure of the resistance to crushing in impact.

(5) Testing the resistance of the edges to crushing wear. The test recommended is Gary's, in which 5 kg. of 3-cm. to 6-cm. graded stone is given 6,000 revolutions in a special drum, and then screened over sieves of 6, 3, 2.5, 1.5, 1 and 0.5 cm., the sieve analysis giving a measure for the breakdown of the edges.

(6) Testing for resistance to wear. This concerns the stone substance proper, and is determined by taking a cube 7.1 cm. on an edge (thus a 50-sq. cm. surface), and submitting it to the action of a grinding plate, using emery. After each 150 revolutions of the plate the specimen is turned 90 deg. and the loss of weight determined. Loss of weight after 600 rotations gives the index of wear.

PROF. DR. G. BERG, Prussian Geological Survey, Berlin: *What Petrographic Properties Are of Particular Importance for the Technical Suitability of Stone?*

AFTER a brief review of the connection between the technical properties of a stone (strength, resistance to wear, permeability, resistance to frost, etc.) and the composition and structure of the mineral, the author shows that, among the chemical properties, the water percentage has by far the greatest influence on strength; he cites the water content of mica, which is easily split, and that of other products which are the first to disintegrate. The "sunburn" of basalt, according to Holler and Diehl, is due to the presence and distribution of a streaky hydrate glass in the mass. On the heating of the stone—and in bright sunshine this takes but a few hours—fine hair cracks are formed along the glassy streaks. The basalt loses even its conchoidal type of fracture. Changing weather conditions can exert an effect even in the interior and, in the case of basalts which are easily disintegrated, the hair cracks lead rapidly to the hydration, decay and crumbling of the whole stone.

Chemical Analyses vs. Physical Tests in Measuring Quality of Cement

By AMAN MOORE
President Cement Securities, Ltd.

MY contention is that during the past forty years or more our progress of improvement in the quality of Portland cement has been very, very slow. The reason for this fact is that we have been measuring the quality of cement from the standpoint of results instead of causes.

The following analyses were made from Portland cements produced during the earlier development of the process of its manufacture (Eckel, 3d ed., Table 221, p. 520):

ANALYSES OF PORTLAND CEMENTS, 1849-1873

Ingredients	Samples			
	1	2	3	4
Silica (SiO_2)	18.60%	22.23%	23.72%	18.00%
Alumina (Al_2O_3)	11.30	7.75	7.36	4.75
Iron oxide (Fe_2O_3)	17.90	5.30	5.05	5.60
Lime (CaO)	49.80	54.11	54.40	58.50
Magnesia (MgO)	0.70	0.75	0.86	2.55
Alkalies (K_2O, Na_2O)	[1]	1.76	2.62	1.70
Sulphur trioxide (SO_3)	[1]	1.00	1.12	2.10
Carbon dioxide (CO_2)	[1]	2.15	2.80	0.50
Water	[1]	1.00	0.96	0.50

[1]Not determined.

We have truly made great progress in the chemistry of Portland cement since the early period of its history. It is significant, however, that, in these early analyses, the iron content exceeded the alumina content in two analyses (No. 1 and No. 4) and that in the other two analyses (No. 2 and No. 3) the iron content was almost as great as the alumina content.

When Aunt Jemima makes her hot cakes, or her hot biscuits, she is very careful indeed to measure the exact amount of the different ingredients that enter her batter. If this is true in the art of baking biscuits or making pancakes, then, how much more true is the fact that the different elements entering into the composition of Portland cement must be proportioned by exact chemical prescriptions. The addition or subtraction of a hundreth part of one per cent. of any one of the more essential elements that enter into the several important compounds produced in the process of manufacturing Portland cement will show a marked difference in the quality of the product.

The particular elements I refer to are silica, alumina, iron, and lime. The essential compounds produced are: (1) three of lime to one of silica, or tricalcium silicate; (2) the combination of three of lime with one of alumina in the form of tricalcium aluminate; and (3) the combination of alumina, iron, and lime in the formation of calcium-ferroaluminate. These three are the really important compounds that give strength to Portland cement. All other compounds—such as magnesium compounds, sulphur trioxide, dicalcium silicate, and, possibly, some other compounds in lesser quantity—are of no significance, since they are merely adulterants. We will, therefore, confine ourselves to the three compounds above mentioned and the elements combining to form such compounds.

The standard specifications of the various scientific bodies have largely been confined to results instead of causes. In other words, it has been a question of testing the materials after they have been produced instead of prescribing standard measures for proportioning the mix used in the production process. Going back many years in the history of the Portland-cement industry in this country and copying from Eckel (3d ed., Table 222, p. 522) the list of analyses of various brands of Portland cements will be of great interest. Also, we find from these analyses the following variations in the percentages of the different elements entering into the raw mixes used in the manufacture of several brands of Portland cement.

Ingredient	Highest Percentages	Lowest Percentages
Silica	24.00	19.05
	24.12	19.56
	24.24	19.92
Alumina	9.74	4.51
	9.83	4.80
	10.11	4.80
Iron	4.75	1.66
	4.81	2.40
	5.18	2.54
Lime	64.36	58.07
	64.96	59.24
	65.44	60.00

It is my contention that there should be no variations whatsoever, that the different elements should be combined in the raw mix in exact percentages. I have offered the following analyses as a perfect raw mix for manufacturing Portland cement:

Ingredient	Per Cent.
Silica	18.89
Alumina	6.55
Iron oxide	4.74
Lime	65.41
Magnesia	1.61
Sulphur anhydride	1.30
Loss	.90
	99.40

The probable constituency of this cement is as follows:

Ingredient	Per Cent.
Tricalcium silicate	71.85
Dicalcium silicate	00.00
Tricalcium aluminate	9.35
Calcium-ferro aluminate	14.39
Magnesia	1.61
Calcium sulphate	1.30
Ignition loss	.90
	99.40

The ratio of the silica to the iron-plus-alumina in this cement, which I will term "perfect" Portland cement, is 1.673.

The total percentages of the three quick-hardening elements in this "perfect" Portland cement are as follow:

Ingredient	Per Cent.
Tricalcium silicate	71.85
Tricalcium aluminate	9.35
Calcium-ferro aluminate	14.39
Total	95.59

My contention is that there are no natural clays which will give a perfect mix that will produce a "perfect" Portland cement having an analysis as above given. Such a mix can only be produced by the blending of three or more raw clay materials. Raw lime, of course, must be blended with the clays. The clay, however, is never perfect in its natural state and there must be blended with it high-iron clays, or iron ore in the raw state, also high-alumina clays, or bauxite in the raw state. With the high-iron and high-alumina materials blended with the ordinary clay and limestone a perfect raw mix can be secured, and this, when properly clinkered, will produce "perfect" Portland cement, the analysis of which has been given above. A cement of this type will obtain almost its full strength in 24 hr.; will not retrogade; and, being comparatively free from other elements or compounds which are more or less adulterants, it will obtain its maximum strength, in the shortest time, when used in concrete construction work. In view of these facts, I am, therefore, urging that chemical analysis be selected as a gage or measuring stick in the adoption of standard specifications for the manufacture of Portland cement.

During the past forty years, as above stated, there has been but little progress made in improving the quality of Portland cement. There has, perhaps, been more improvement made in the last few years than in the previous period of time, since the discovery of Portland cement was made more than a century ago. If the same time and energy had been devoted to a study of the chemical analysis and constituents of the compounds of cement that has been given to the physical tests of cement after it has been manufactured, then much quicker progress would probably have been attained in perfecting the quality of Portland cement.

Because of the fact that loose specifications for measuring the quality of Portland cement have prevailed obsolete cement plants in the United States have been able to continue operating and producing Portland cement that has passed the standard specifications. Many of the plants operating in the United States to-day are obsolete. A modern plant, with a primary crusher, a secondary crusher, one raw-grinding compartment mill, one kiln, one cooler, and one closed-circuit compartment finish-grinding mill, will produce 6,000 bbl. daily of quick-hardening cement at a lower cost than many obsolete plants can produce ordinary Portland cement. In other words, six pieces of modern machinery will produce what requires from 30 to 50 pieces of machinery in most of the obsolete plants now operating in the United States. Long kilns assist in the perfect burning of clinker, while large crushing units and grinding machines will do more perfect grinding and more intimate mixing. The fewer units now needed will cause greater fuel economy and a great saving in labor costs.

There are only a few plants, operating in the United States to-day, that have a perfectly blended clay that will produce a "perfect" Portland cement. If the standard specifications for the adoption or rejection of Portland cement were applied as rigidly as they should be, it would automatically close a number of present plants in the United States. The plants are obsolete and should be dismantled. But, of course, considering the tremendous loss the owners and stockholders of such companies would sustain, there should be a gradual tightening up in the specifications over a period of, say, five years, so that there would be no immediate total loss in the investment in such obsolete plants.

Another way to avoid such a loss would be the effecting of one or more huge consolidations that would combine many of the plants in the United States. The closing down of the obsolete plants and the building of a few new and modern plants, properly-equipped to make a "perfect" Portland cement, would solve the problem. The gain in improved quality and the lowering of manufacturing costs would soon offset the loss sustained in the taking over, through consolidations, of the obsolete plants, and these could be promptly dismantled after their acquisition. A control of the market would be accomplished. The loss of dismantling the obsolete plants could be carried on the books as "good-will." In a few years the cost of acquiring such plants could be written off by the saving in the manufacturing costs in producing "perfect" cement far superior to many of the brands now produced in the United States, and the standard specifications, covering the correct analyses of the product as well as the physical tests, could be made so tight after a few years more that there would be no possibility of the old obsolete plants marketing their products, since they would be unable to produce a product that would pass the standard specifications.

Broken Tire on Rotary Cement Kiln Reclaimed by Welding

When the superintendent of a cement mill in the Pacific Northwest was faced with the problem of repair or replacement due to the breaking of a kiln tire 36 ft. in circumference and weighing 4 tons, he cast about for some method of avoiding the usual expense. Knowing of the ease with which the oxy-acetylene process could be applied to all types of metal repair, he determined to find out whether it could solve his problem and accordingly requested an oxy-acetylene service operator for advice. Under the latter's supervision, the job was started, according to *Oxy-Acetylene Tips.*

Since the tire had fractured in two places on opposite sides of the kiln, it was necessary to arrange

(Continued on page 55)

Methods and Costs of East Texas Gravel Co. Operations, Bois D'Arc, Tex.*

By WALTER W. HYDE

THE gravel deposits of this company are located in the southwestern part of Kaufman County about 20 mi. southeasterly from Dallas and approximately 5 mi. south of the main line of the Texas & New Orleans Railroad (Southern Pacific Lines) at Bois D'Arc. From this point a standard-gage railroad track has been constructed, connecting the main line with the loading tracks at the deposits.

In early operations a small drag-line machine was used to remove the overburden and then to excavate the sand and gravel and load it on standard-gage railroad cars. The material was used for railroad ballast, but the demand for other uses grew so rapidly it was soon necessary to increase production, and the present plant is the result of a gradual development brought about by the necessity of producing various special grades of sand and gravel.

Description of Deposits.—The sand-and-gravel deposits, which lie in the immediate vicinity of Dallas and in close proximity to Trinity River and its tributaries, are quite similar in character and, as a general rule, are all more or less subjected to overflowing by flood waters.

The deposits were derived from the disintegrated and broken fragments of the hard limestone and sandy formations of the Commanche and Carboniferous rock to the west. Their origin is proved conclusively by the character of the constituents and by the fossils found in them.

Unquestionably these materials were worked downstream, largely by flood waters, to form these gravel deposits and the materials, while in transit, were not only rounded by abrasion but were to a considerable extent segregated by size in the swift currents, so that from point to point it is noticeable that the pebbles and grains of sand differ in shape as well as in size. Often the dividing line between two or several adjoining deposits is remarkably well-defined.

The Trinity River flowed over many different outcrops of rock, with the result that the amount and kind of materials contributed to the stream load have differed. This is exemplified by the difference between the upland gravel deposits and those found in the present flood plain of the river.

The upland gravel deposits are not as valuable as the flood-plain deposits as they carry great quantities of foreign materials, such as clay, mud, soft limestone, chalk pebbles, etc., well mixed with rather poor grades of sand and gravel. However, the raw material from these deposits makes excellent driveways or country roads where traffic is light, due to the natural binders contained in the gravel.

The flood-plain deposits, where proved to contain material of sufficient quality and quantity to justify exploitation on a large scale, are very valuable. They are usually free from foreign material, such as soft limestone, chalk pebbles, mud, clay, and silt, and, therefore, may be mined and made into a finished product with the minimum of expenditure.

Gravel deposits in this locality, and, for that matter, throughout northeastern Texas, are small, usually not exceeding 40 to 50 acres in area and averaging 20 to 25 acres. However, a number of these deposits are often found close together. The deposits are also comparatively shallow. The upland deposits have practically no overburden and are from 3 to 5 ft. thick, whereas the flood-plain deposits are covered with 8 to 12 ft. of soil and clay overgrown with trees and brush, and vary from 8 to 20 ft. in thickness. The deposits are usually underlaid with a hard blue shale or a stratum of solid limestone. However, in many cases the base of the gravel beds is a hard clay.

The beds themselves are composed of silica and limestone in the form of sand and pebbles both which are uniform in texture throughout. The sand is angular and hard, and the pebbles are also hard, well-formed, and of the right size for a number of uses.

Prospecting and Exploration.—Locating gravel deposits on the upland is a comparatively simple matter as the gravel sometimes outcrops or is usually detected in the soil within a few inches of the surface, or is exposed in gully washes along the banks of small streams that drain the high ground. Often the upland deposits are found accidentally in digging post-holes.

Locating gravel deposits on the flood plains is more difficult, as the gravel is covered by 8 to 12 ft. of clay and soil and prospecting is expensive as the clay is both hard and deep. Further, commercial deposits are seldom discovered, even though a prospector may spend months in sinking holes with a boring machine or digging prospect shafts.

When a deposit has been located, it is usually explored by means of test pits dug by hand to the top of the gravel. If the pit is dry, hand digging may be continued through the deposit. Where this method is used, one man to a hole is all that is necessary for the first 7 ft. of depth. From this point on, there are two men to the hole, which is usually 3 ft by 5 ft. in cross section through the overburden.

One man on the surface lays across the hole a plank on which to stand and uses a 1-in. rope—large enough to keep from burning the hands while gripping it—to hoist a steel bucket that holds about ½ cu. ft. of gravel. The man in the hole digs and loads material into the bucket.

* Reprinted from U. S. Bureau of Mines Information Circular 6,537.

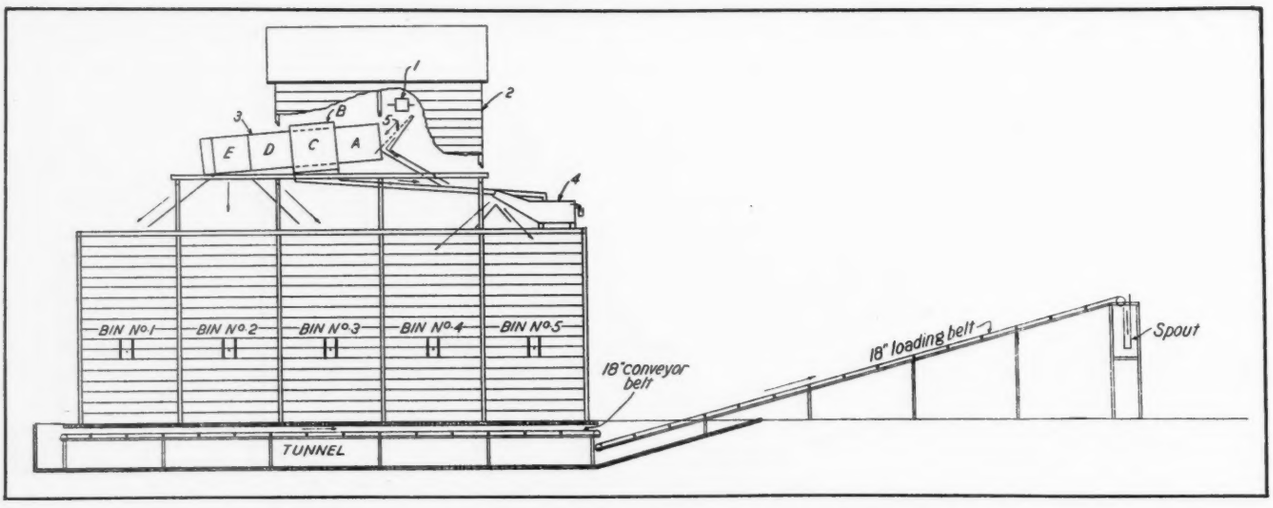


Fig. 1. Side elevation of bins and loading conveyor and longitudinal section of tunnel.

When the surface of the gravel deposit has been reached, it is well to change from a 3-ft. by 5-ft. oblong hole to one that is round and about 3 ft. in diameter. If the gravel is not too loose, the man in the hole will be safe in going down in the gravel to a depth of 10 to 12 ft., or to 20 to 25 ft. below the surface. Should the gravel be extremely loose, a specially-constructed steel curb, in sections, should be used for the protection of the man in the hole.

One gravel company in this vicinity has a boring machine, similar to a post-hole auger on a large scale, that is mounted on and operated by a Fordson tractor. This machine bores a hole about 16 in. in diameter through the clay overburden at the rate of 1 ft. to 5 ft. per min., depending on the hardness of the clay; and, in case the hole caves, the auger can be pulled by reversing the direction of rotation. The machine drills in clay to a depth of about 18 ft. without difficulty, but it does not work so well in the gravel because of the continual falling of pebbles, which causes many cave-ins. For this reason drilling is stopped immediately upon striking the gravel, and the hole is continued by using a small orange-peel bucket, operated by hand, inside a 14-in. steel casing. This is a good outfit for working in loose gravel above the water line.

When the water is struck, faster progress may be made by using a flap-valve bailer—a bailing bucket used in bailing oil wells or other deep wells. The bailer used for sinking through gravel under water is operated inside a 10-in. pipe. It is usually 8 in. in diameter and is fitted on one end with a 3-pronged, hard-tempered cutting edge. Should the bailer be operated by hand, it should not be more than 2 ft. long. As many as 8 men, working 6 at a time, will be needed to make the best progress. The bailer is suspended from a light derrick, mounted on a sled, and is worked up and down by a 1-in. rope running through a pulley at the top and one near the base. The derrick on the sled is moved by team, tractor, or by the crew of 8 men.

The bailer, when used on a self-moving well-drilling machine of the cable type, has proved successful in testing gravel deposits which lie below the water. Two men can operate this equipment to good advantage, and they can usually drill from 70 to 80 ft. in 10 hr.

Nature of Deposit.—The gravel deposits near Bois D'Arc, now being worked by the East Texas Gravel Co., are typical flood-plain deposits with all the peculiar characteristics so noticeable in the many other similar deposits lying close to Trinity River which are being worked by other operators.

The company's deposits cover several hundred acres and the overburden of clay ranges between 4 and 12 ft. The sand and gravel have a depth of from 10 to 15 ft. The pit-run material averages about 45 per cent. sand and 55 per cent. gravel, and is fairly clean. The deposit lies below the normal water level, which comes up to the base of the clay overburden.

The materials, both sand and gravel, in these deposits, are of exceptional quality; being free from mud, clay, soft limestone, chalk pebbles, etc., and particularly free from a medium-soft white limestone pebble which is mixed in small amounts with the sand and gravel from pits some 50 mi. farther up Trinity River. The sand is angular, coarse, and hard, and is prepared by washing and sizing so that it meets practically all specifications, especially for concrete construction of different kinds.

Screen analyses of average samples of washed sand and washed gravel for concrete follow:

	Screen (*in.*)	Sand (*per cent.*)
On	½	00.0
On	¼	18.0
Through .	¼	82.0
Total..		100.0
	(*mesh*)	
On	10	33.6
On	20	54.2
On	30	76.6
On	40	89.2
On	50	95.6
On	60	97.2
On	80	97.9
On	100	98.2
On	200	98.3
Through .	200	1.7
Total..		100.0

	Screen (*in.*)	Gravel (*per cent.*)
On	2	00.0
On	1½	1.5
On	1¼	7.1
On	1	19.1
On	¾	45.3
On	½	72.7
On	¼	94.6
Through .	¼	5.4
Total..		100 0
	(*mesh*)	
On	10	99.5
On	20	.5
Total..		100.0

The gravel is hard and tough, and particularly well adapted, because of size and quality, to use in concrete structures such as building columns, side walls, floor slabs, and all kinds of highway-drainage structures. It also fully meets specifications required by the Texas Highway Department and federal engineers for the construction of concrete slabs and hard-surface tops of permanent highways.

The gravel and sand are thoroughly washed and rinsed, and sized to meet specifications for many different projects.

Only a small percentage of the gravel exceeds 3 in. in size and for this reason no crushing is necessary. All the "oversize" is sold to the railroads, or to contractors who do their own crushing on special jobs.

Stripping and Mining.—Removal of clay overburden and excavation of raw pit gravel is done by a Monigham walking drag-line with an 85-ft. boom and a 3-cu. yd. bucket. This machine is powered by a 175-hp. Fairbanks-Morse Diesel engine belted directly to a shaft with clutches connecting with two drums on the hoist used for dragging and hoisting the bucket. There is also a belt to an electric generator which supplies current for a 50-hp. motor directly connected by pinions and gears to a circular rack for swinging the machine.

The drag-line is put to work at any desired location in the pit, and first removes the overburden of clay which it casts to one side, usually at about 90 deg. from the direction of the loading truck. After the overburden has been removed from about 5,000 sq. ft., the drag-line proceeds to remove the pit gravel and places it in standard-gage, bottom-dump, 50-ton steel cars for transport to the Texas & New Orleans Railroad track to Bois D'Arc. From there it is transported to designated points along the main line and used for ballast.

The ballast cars are often utilized for transporting the pit gravel as loaded by the drag-line to the hopper at the washing plant. The ballast cars are "spotted," one at a time, over the hopper and dumped.

Screening Plant.—The raw material is fed from the hopper by a plate-feeder to an 18-in. belt-conveyor that carries the material to the top of the washing plant over a head pulley shown in Figs. 1 and 2. Fig. 1 shows a side elevation of the washing plant and a longitudinal section of the tunnel under the bins. Fig. 2 shows a side elevation of the conveyor-belt from the hopper, an end view of the bins, and a cross-section of the hopper and the tunnel under the bins. The top portion of the house which covers the belts and electric motors that drive the 18-in. conveyor-belt, revolving scrubber, and screen is shown at 2 in Fig. 1.

From the head pulley (1) at the top of the plant the pit gravel is sluiced over an inclined screen (5) of ⅛-in. steel wire having ⅜-in. square openings. The "undersize" from this goes directly to the two sand classifiers (4), thus relieving the revolving screen of this burden and speeding up production. The "oversize" from the inclined screen is flushed into the revolving scrubber and screen (3), which is 18 ft. long and 4 ft. in diameter, and is surrounded midway by a wire jacket (B) that is 6 ft. in diameter and 9 ft. long. The jacket is made of ⅛-in. steel wire with ⅜-in. square openings for the first 5 ft. of its length and ½-in. square openings for the remaining length of 4 ft. The scrubber portion of the revolving screen (A) is on the receiving end and is 5 ft. long. It is followed by sections C, D, and E, which are 6, 4, and 3 ft. long and have ⅝, 1⅜, and 3-in. round perforations, respectively.

The sand and water passing through the screen jacket are sluiced to two sand classifiers (4), placed side by side. These wash, size, dewater, and deposit the sand in bins 4 and 5. The sand classifiers are of the box type, with long sloping necks in which sand-drags are operated. Each sand-drag consists of two parallel chains mounted on cast-steel sprocket wheels and connected by steel plates ⅜ in. thick, 5 in. wide, and 30 in. long. The sand-drags, driven by gear and pinion, agitate the sand and keep dirt, silt, etc., in suspension to float off with the water, while the sand is dewatered and dragged out through the neck of each classifier.

The inclined screen ahead of the revolving scrubber and screen and the jacket have removed

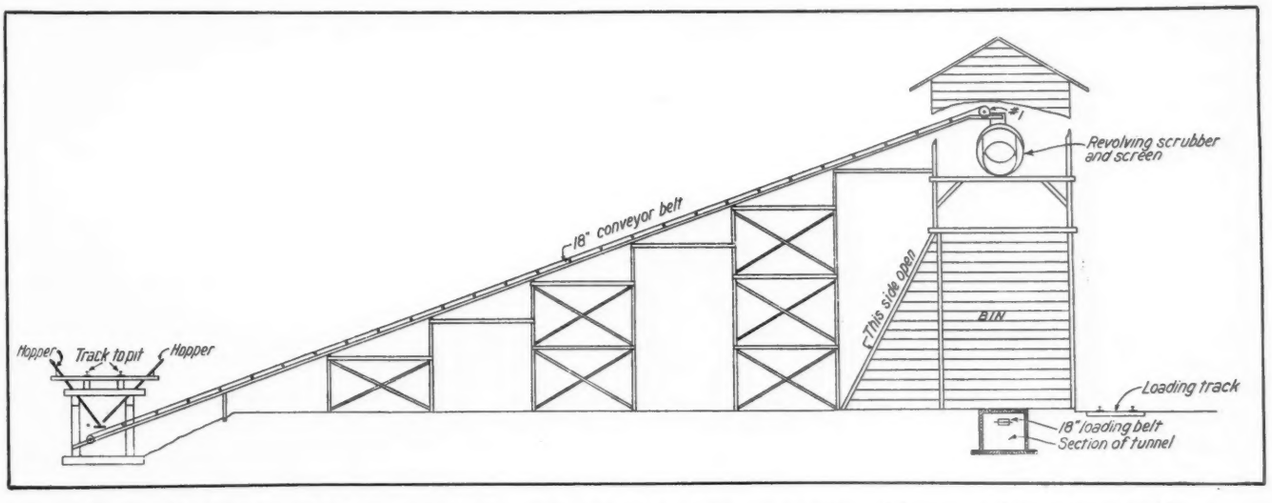


Fig. 2. Side elevation of belt-conveyor incline, end view of bins, and cross-section of hopper and tunnels under bins.

most of the sand and water, leaving only the pebbles to be screened into three sizes and chuted to their respective bins. Referring to Fig. 1, bin 3 is for pebbles that pass through a $\frac{5}{8}$-in. ring and are retained on $\frac{3}{8}$-in. square-mesh opening. Bin 2 is for pebbles that pass through a $1\frac{3}{8}$-in. ring and over a $\frac{1}{2}$-in. opening. Bin 1 is for pebbles that pass through a 3-in. ring and over a $1\frac{3}{8}$-in. opening. The different sizes may be loaded out individually into cars through the gates on the side of each bin, or may be remixed in any desired proportion in a trough immediately under the revolving screen and from there spouted directly to the cars on the loading track for shipment.

In many instances where it is necessary to be more particular about the proportions of the several sizes, mixing is accomplished by use of the loading belt as follows:

Underneath the bins as shown in Fig. 1 and 2 is a tunnel having a 7-ft. by 7-ft. inside cross-section and running parallel with the longitudinal axis of the plant. At intervals along the roof of tunnel, which forms a portion of the bottom of the bins, are gates spaced from 10 to 12 ft. apart along the center-line. An 18-in. conveyor-belt traverses the entire length of the tunnel, and the flow from the bins to the conveyor-belt is regulated by adjusting the bin gates to produce any desired specification. Small hoppers straddling the conveyor-belt are placed beneath the various bin gates to guide the discharge. After passing out of the tunnel the gravel is discharged to another conveyor-belt which rises to a point high enough to permit spouting the material over an inclined screen, where it is sprayed with water with sufficient force thoroughly to rinse the gravel before it is placed in the car for shipment.

Using the small drag-line machine at the washing plant to stack pea gravel and sand in stock-piles, as well as to reclaim it and load it quickly, has been found to be a most advantageous method. When the sand and pea gravel have been stocked in piles near the washing plant to the capacity limit of open storage, the handling and rehandling of these materials eventually became a problem for, in addition to hauling them to the plant and carrying them through the regular washing process, it was necessary to load them from bins to cars or from storage to cars and, finally, to dispose of them by dumping them as waste somewhere along the line. At first this was not a bad arrangement, as these materials when mixed make an excellent track ballast and were utilized for this purpose. However, when all the track had received an adequate amount of this ballast, the continued disposal of these materials became not only a problem of finding a place at which to dump them, but also an expensive operation.

The disposal of these materials was solved by removing them from the desirable materials and discharging them as waste into the pond formed by previous workings. This method utilizes a portable loading and washing platform loaded by the Monighan walking drag-line for eliminating the undesirable materials, such as large stones and big

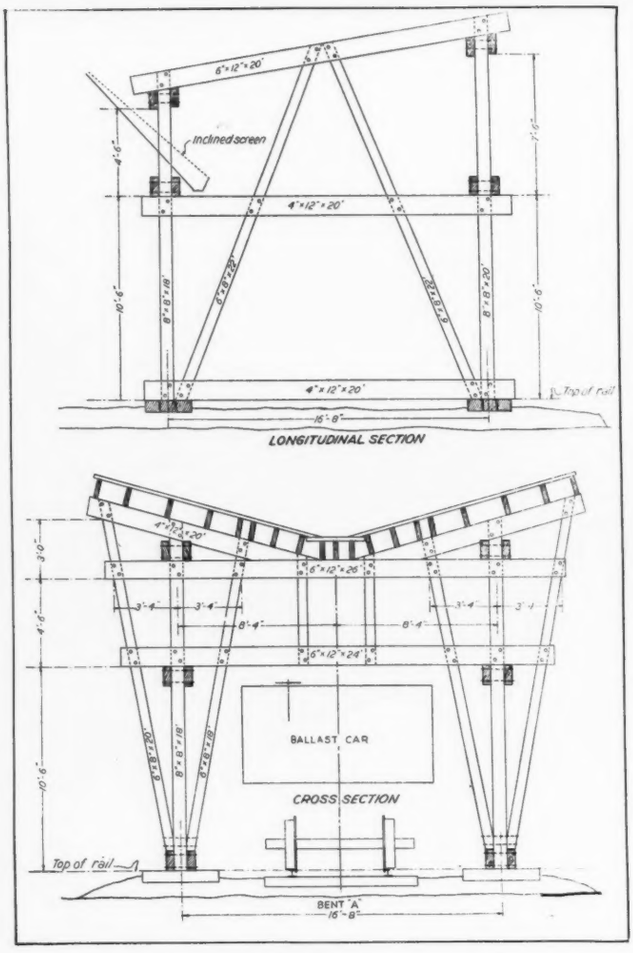


Fig. 3. Sections of the portable platform.

chunks of clay or mud, etc., as well as pea gravel and sand that is overabundant in the pit gravel. Large stones and big chunks of mud and clay are removed from the platform by hand, and the sand and pea gravel are washed away by water that sluices them through an inclined screen and thence by flume back to the excavated areas of the pit. The "oversize" on the inclined screen rolls into standard-gage steel ballast cars for transport to the washing plant. This method of treatment eliminates the haul of waste material, relieves congestion at the plant, and speeds up production of those products for which there was a ready market.

It may be seen (Fig. 3) that the standard-gage ballast cars pass under the platform, and that the floor of the platform slopes two ways, toward the center and also toward an inclined screen at one end. The raw pit gravel is placed directly by the drag-line on the platform floor, which is covered with 10-gage steel plates laid in "rain-proof" fashion. Across the inclined screen and some 18 in. above it several 3-in. pipes are placed, each perforated on one side with $\frac{1}{4}$-in. holes about 1-in. apart, through which water under pressure is sprayed on the screen. When the raw pit gravel is placed on the platform the water, which is played on it through a small hydraulic giant, floods the gravel and sand down grade to the inclined screen which has a pitch of about 45 deg. This pitch is

sufficient to make the "oversize" roll off into the car while the sand and pea gravel are washed through the screen by the force of the water sprays to be flushed through a flume, made up of 25-ft. portable sections, to the worked-out portion of the gravel pit, where it may be picked up again on the next pass with the drag-line or left as waste along with the overburden.

To move the portable platform four timbers (each 8 in. by 8 in. by 12 ft.), a few blocks (each 8 in. by 8 in. by 2 ft.) and two good track jacks are required to raise and block it upon one of the ballast cars. A special pocket was built into the portable platform to hold the timbers, blocks, and jacks so that they are always available when needed. One of the ballast cars is used for a moving van, so to speak, by "spotting" it on the loading track directly under the platform. The four timbers are then placed across the car, two at each end of the platform immediately under the horizontal cross timbers of the platform that are about 18 in. above the top of the car. Both jacks are set, and one end of the platform is raised and blocked on the top of the car, leaving its legs at that end some 8 in. or so above the foundation blocks. In like manner the other end of the platform is raised and blocked, and the whole structure, then clear of all foundation blocks and resting on the ballast car, may be moved by the locomotive to a new location for further use or it may be taken to the end of the loading track to remain completely out of the way until it is again needed.

SUMMARY OF COSTS, JULY 1929 TO JULY 1930

Material loaded during period: Overburden, 110,000 cu. yd. by drag-line into the pond formed by previous workings; sand and gravel, 123,500 tons.

Operating Costs per Ton of Sand and Gravel Mined

	Labor	Super-vision	Power	Fuel	Other Supplies	Total
Operating costs:						
Stripping	$0.025	$0.002	.....	$0.010	$0.022	$0.059
Mining and loading	.049	.005	$0.002	.002	.051	.109
Transportation	.032	.001	.....	.014	.002	.049
Washing, screening and loading	.080	.010	.002	.....	.003	.095
Storage	.005	.....	.....	.001	.005	.011
Repairs and maintenance	.020	.001	.....	.....	.110	.131
Miscellaneous	.006	.....	.....	.....	.005	.011
Total	$0.217	$0.019	$0.004	$0.027	$0.198	$0.465

Water for use on the portable platform is plentiful, there being 10 or more ft. of it standing in the pit at all times. A 6-in. centrifugal pump, powered by a 30-hp. gasoline engine, is used to pump the water through a 6-in. pipe to the top of the platform. The pump and engine remain more or less stationary, but the 6-in. pipe, laid parallel to and about 10 ft. away from the track, is shifted each time the loading track is moved over for the new pass of stripping and loading.

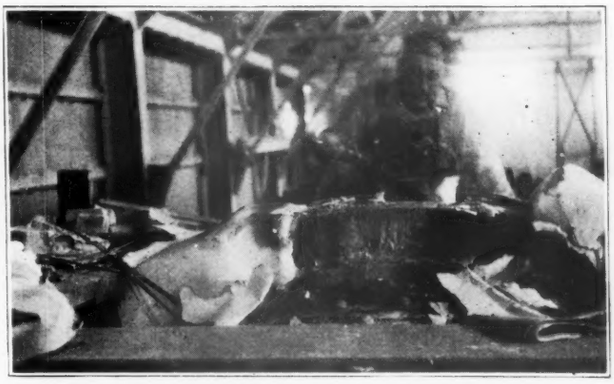
Broken Tire on Rotary Cement Kiln Reclaimed by Welding

(Continued from page 60)

to weld one side one day and the other side the following day.

The first operation was to bevel the edges of the fracture. This was accomplished rapidly with the oxy-acetylene cutting blowpipe. A temporary furnace of brick and asbestos paper was built around the part to be heated, and two oil burners were used to do the preheating. When the casting was at a dull red heat the welding was started. High-test steel welding rod was used to insure proper strength and soundness of weld metal.

In order to take care of the contraction of the weld metal on cooling, the rivets for about 6 ft. on each side of the fracture were removed by the oxy-acetylene cutting blowpipe, and wedges were driven under the tire to expand it sufficiently to allow for contraction. The tread, or top section of the tire was welded first, and while this section was red hot the wedges were knocked out. This put the weld in compression. Next the flanges were welded, one welder working on each side from the flange towards the tread. In this manner they were able to keep the right heat across the tire and prevent the development of internal strains. After the weld was completed it was covered with asbestos paper and allowed to cool slowly.



Welding operator at work repairing the broken kiln tire.

The kiln after tire had been welded.

The next day the kiln was rotated and the other fracture repaired in a similar manner. In this way more than seven-eighths of the usual cost of a new tire and installation was saved. The mill superintendent was so pleased with the results that he immediately started plans for the reclamation of other kiln tires that had been discarded.

Observations and Tests Which Determine When to Discard Wire Rope

By A. S. RAIRDEN
Chief Engineer, American Cable Co.

WHEN to discard a wire rope after it has rendered service to the point where continuance of the rope in service would be at the sacrifice of safety is a question to which various answers are given by users and manufacturers of wire rope.

Practically all wire-rope installations, where the question of safety and human life are paramount, are subject to systematic and frequent inspections. These visual inspections detect deterioration of the rope resulting from the abrasion or wear of the wires and from the development of broken wires, due either to bending fatigue only or also to the wear of the wires to the point of approximately 60 to 70 per cent. of their original diameter and bending fatigue. All such visual examinations cover visible conditions on the outside of the rope and fail to take into account the fact that the inner invisible components making up a wire rope are also subject to the same deterioration in service.

Before proceeding any further, I want to stress the fact that, usually, the outer visible deteriorated condition of the wire rope is indicative of the rate of invisible deterioration. The discussion will center primarily on the invisible deterioration which is least understood by users of wire rope.

Invisible deterioration may rightly be divided into four main classes:

(1) Breakdown of the core and subsequent failure of the core to give proper support to the strands surrounding it.

(2) Development of fatigue breaks in the outer series of wires next the core in the strands surrounding the core.

(3) Corrosion of the inner series of wires and of the outer series of wires next the core in the strands surrounding the core.

(4) Development of fatigue breaks in the inner series of wires in the strands surrounding the core.

(1) *Breakdown of the Core.*—Breakdown of the core may be identified by the rapid development of numerous square-off fatigue breaks of the outer wires on the crowns of the strands and the development of square-off fatigue breaks of the outer wires along the lines of contact between the strands. This condition is accompanied by severe abrasion or nicking of the outer wires along the lines of contact between the strands.

Premature breakdown of the core due to faulty design will always show up by the premature development of broken wires as just described without any perceptible wear of the wires on the crowns of the strands.

The evidence caused by the breakdown of the core is greatly similar to that caused by failure of the outer wires in a rope due to severe bending fatigue; in the latter case, however, broken wires will not usually appear along the lines of contact between the strands and there will be no perceptible abrasion of the outer wires along the lines of contact between the strands.

A correctly-designed core will eventually, especially in long-lived ropes, deteriorate in service and will give less and less support to the strands surrounding the core. Deterioration of the core due to the natural course of events is, of course, accompanied by marked deterioration of the outside of the rope due to wear of the wires and to the development of fatigue crown breaks.

(2) *Fatigue Breaks in Outer Wires.*—Development of fatigue breaks in the outer series of wires next the core is proportionate to the development of fatigue breaks in the visible wires and *inversely to the load applied to the rope.*

To enable the carrying out of an exhaustive series of experiments to bring out the facts surrounding this type of invisible deterioration, the fatigue-test

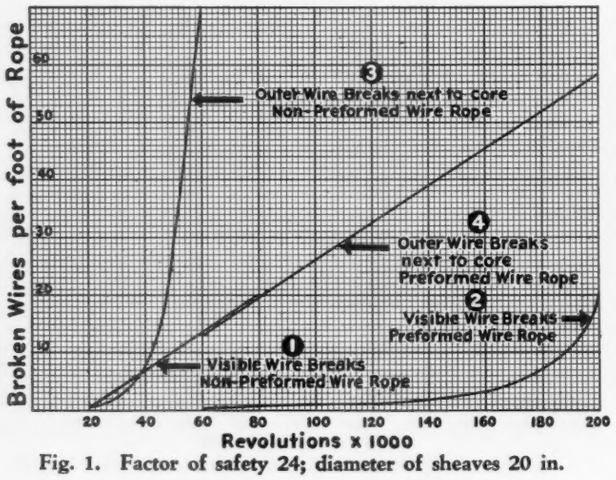


Fig. 1. Factor of safety 24; diameter of sheaves 20 in.

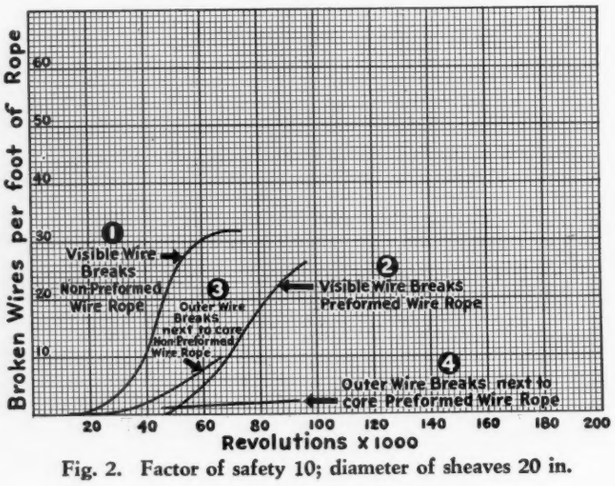
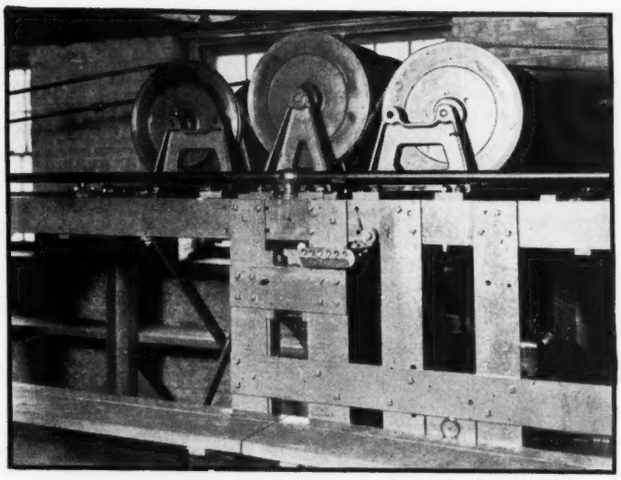


Fig. 2. Factor of safety 10; diameter of sheaves 20 in.



Fatigue-test machine for determining invisible deterioration.

or life-test machine as illustrated was used. In making a test a test-length of rope is caused to travel back and forth over the three sheaves which are free to rotate around their axes. The desired tension or load is applied to the rope subjected to the test. With the first appearance of visible broken wires the rope is removed and taken apart to determine the number of broken outer wires, next the core and invisible from the outside, within the test-length of rope.

Tests of this kind were made and subsequent ropes were run to gradually-increasing rates of final deterioration arriving in equal increments at the severest condition of deterioration as evidenced by the number of broken visible wires. In every case, when the desired point of final deterioration was reached, the test rope was removed and examined to determine the number of broken outer wires next the core. All the test-lengths were cut from the same length of rope possessing uniform characteristics throughout.

These tests were conducted on preformed rope and non-preformed or ordinary rope in order to find out how both types of rope reäcted. By preformed rope is meant a rope in which the strands have been preformed or preshaped to the spiral path that they naturally assume when twisted around the core. In this type of rope all torsional or untwisting forces have been removed and the rope, when cut without the application of seizings, will not fray or fly apart.

The tests were carried out under two different conditions of tension. One series of tests was performed with load applications to the rope equal to 1/24 the breaking strength of the rope, and the second series of tests with load applications to the rope equal to 1/10 the breaking strength of the rope.

Referring to the graphical interpretations of the results, Fig. 1 represents the load application with a factor of safety of 24 and Fig. 2 represents the load application with a factor of safety of 10.

Curves 1 and 3 in both Figs. 1 and 2 represent the relationship between the outer or visible broken wires and the invisible broken outer wires next the core in a non-preformed rope. Curves 2 and 4 in both Figs. 1 and 2 represent this same relationship in a preformed rope. Fig. 3 is an explanatory view of a rope section showing the visible outer strands and the outer wire of a strand next the core.

At a condition of deterioration equal to 20 broken wires per ft. of rope visible on the outside of the rope, we can present the following interesting table:

Number of Broken Outer Wires Next the Core per Foot of Rope

Factor of Safety	Non-preformed Rope	Preformed Rope
24	153	58.4
10	3.7	2

The life of the various ropes may be expressed in terms of percentage at the points of final deterioration (20 broken wires per ft.) as follows:

Factor of Safety	Non-preformed Rope	Preformed Rope
24	40%	100%
10	23%	41%

The length of life under light loadings is undoubtedly greatest. This is, of course, gauged by the visible deteriorated condition of the ropes. In reality the ropes have been run to the point where a sacrifice in safety has occurred.

The factor of safety equal to 10 more nearly approaches actual conditions of wire-rope usage on field equipment and, with the existence of this condition of loading, we can be assured of the condition of deterioration of the outside of the rope being indicative of the time at which the rope should be removed from service, for the rate of invisible deterioration progresses at a much slower rate. Very frequently in service parallel systems of wire-rope reeving are called upon to move certain loads (elevators especially), and from these results the conclusion may be readily drawn that the tension on all ropes should be as nearly equal as possible, so that every rope may bear its share of the load.

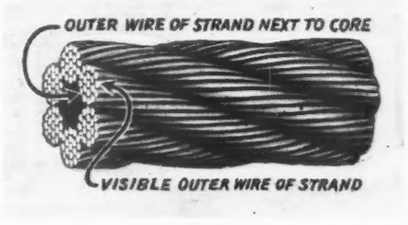


Fig. 3.

In actual field checks of conditions of unequal or uneven deterioration of ropes used in parallel systems of hoists, we have found that unequal tensions have been responsible for the premature inside breakage of wires. These parallel systems of hoists have usually used rope cut from the same initial length and we may assume that the physical characteristics of the rope were uniform throughout.

Fatigue crown breaks of wires both on the outer exposed strand crowns and on the strand crowns bearing against the core of the rope are caused by the magnitude of the fiber stress in the wires due to bending, the ratio of this stress to the ultimate tensile stress of the wires and the number of repeated bends the wires receive.

The wires bent to the smallest radius of curvature develop the greatest bending fibre stress and will fail the quickest.

Considering in Fig. 4 cross-sectional plane *XY*, through a wire rope bent around a sheave, as illustrated diagrammatically below, the magnitude of the resultant fiber stress due to the radius of curvature of the wires will vary from the greatest to the smallest values in the order of *a, b, c, d.*

It is then natural to expect that the wires when subjected to the same number of bends will fail in the order *a, b, c, d.*

However, when the rope is subjected to a certain applied load, the strands develop a compressive radial pressure on the hemp core. This hemp core in turn exerts an equal and opposite radial tensional force. This radial tensional force increases with increased loads on the rope and reacts also opposite to the bending fiber stress developed in the wires. While the radial tensional force of the hemp is increased it also reacts opposite to the bending fiber stress in the wires and tends to decrease the resultant magnitude of the bending fiber stress, thereby increasing the ratio between the bending fiber stress and the ultimate fiber stress of the wires and in turn increases the life of the wire under repeated bending.

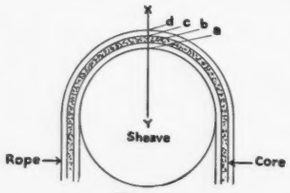


Fig. 4.

The conclusion is, therefore, that the fatigue life of the outer wires of the strands next the core is proportionately increased as compared to the fatigue life of the outer wires on the outer strand crowns with increased loads on the rope.

(3) *Corrosion of Inner Wires.*—Corrosion of the inner series of wires and of the outer series of wires next the core may be readily prevented by frequent applications of lubricants. In cases where ropes are operating under wet or moist conditions it is recommended that the initial application of lubricant in the field be carried out before the original lubrication of the rope, put on during manufacture of the rope, has worn off. If the original lubricant is allowed to wear off, the surface of the wires in the rope will take on a hydrated iron oxide which is hard to remove with subsequent applications of lubicant. Future applications of lubricants will roll off immediately.

Visible corrosion, provided that the rope is properly and frequently lubricated, is always indicative of invisible corrosion of the inner series of wires and of the outer wires next the core.

(4) *Fatigue Breaks in Inner Wires.*—The development of fatigue breaks in the inner series of wires in the strands surrounding the core always follows after marked deterioration of the outside of the rope. The rate of development of these breaks in the wires is dependent upon the radius of curvature assumed by the wires. The wires possessing the least radius of curvature will fail before the wires possessing the greatest radius of curvature. This radius of curvature is the radius of the path of any particular point in the helix of the strand, the rope being curved over a sheave or drum. The value of this radius of curvature, ρ, may be expressed by the formula

$$\rho = \frac{R_p^2 + h^2}{R_p}$$

in which R_p is the pitch radius of the helix of the strand. This is obtained by subtracting the diameter of the strand from the diameter of the rope and dividing by 2. The letter h is the pitch of the helix which is equal to the length of lay of the rope. In a wire rope the outer wires practically always possess less radius of curvature than the inner series of wires. From this it follows that the outside deterioration of a wire rope will always call for its removal before many of the inner series of wires have had a chance to break due to fatigue.

Report Reviews Use of Mortar-Void Method of Proportioning

The Use of Mortar-Voids Principle in Designing Concrete Mixes, by V. L. Glover, engineer of materials, Illinois Division of Highways, reviews in a concise manner the general problems encountered in proportioning concrete and gives a complete history of one year of field experience with the mortar-void method of proportioning.

It discusses the two basic principles of the mortar-void theory, which are:

(1) That other things being the same, the strength of the concrete is equal to the strength of the mortar.

(2) That definite quantitative relations exist between the magnitude of the voids in the concrete and the strength of the concrete.

Then follows an explanation of: (a) Steps in design, (b) Mortar-void tests, (c) Relative water content, (d) Amount of coarse aggregate. The mortar-void method permits a mathematical study of the economy of various mixtures. A study of available data indicated that for conditions in Illinois the economical strength at 14 days age was 650 lb. per sq. in. in flexure, and 3,500 lb. per sq. in. in compression.

"Essentially our specifications assume the responsibility for obtaining the required strength, and we undertake to furnish the contractor with the proportions which we believe will produce this strength," says the report. "Such a specification does not penalize the contractor for failure to obtain the required strength.

"Preliminary work included making mortar-void determinations on 110 samples of fine aggregate from different sources. For constant strength a maximum variation of 50 lb. of sand per bag of cement was found in the case of a few sands."

The result verified in practically all cases the predetermined laboratory proportions. The following table contains the results of modulus-of-rupture tests from 254 paving jobs, representing approximately 800 mi. of pavement.

Age (*days*)	3	5	7	10	14	21	28
Number of tests	2,014	2,406	3,798	682	8,738	486	5,080
Modulus of rupture	455	552	607	657	693	725	767

MEN OF THE INDUSTRY

The portrait printed on this page in each number of PIT AND QUARRY is selected without significance as to current events or the position of the individual in the industry.

HUGH HADDOW, JR.
Vice-President and General Manager
Menantico Sand & Gravel Co.
Millville, N. J.

Coming Events

Jan. 9-15, 1932. Detroit, Mich. Annual Convention and show, American Road Builders' Assn. Chas. M. Upham, engineer-director, National Press Bldg., Washington, D. C.

Jan. 14, 1932. St. Louis, Mo. Monthly meeting, St. Louis Quarrymen's Assn., Forest Park Hotel. E. J. McMahon, exec. sec., 4063 Forest Park Blvd., St. Louis, Mo.

Jan. 19-22, 1932. Pittsburgh, Pa. Annual Convention, National Crushed Stone Assn., Wm. Penn Hotel. J. R. Boyd, secretary, Merchandise Bldg., Washington, D. C.

Jan. 25-26, 1932. Pittsburgh, Pa. Annual convention, National Ready-Mixed Concrete Assn., Wm. Penn Hotel. V. P. Ahearn, executive secretary, Munsey Bldg., Washington, D. C.

Jan. 27-29, 1932. Pittsburgh, Pa. Annual convention, National Sand & Gravel Assn., Wm. Penn Hotel, V. P. Ahearn, executive secretary, Munsey Bldg., Washington, D. C.

Feb. 3-4, 1932. Washington, D. C. Annual meeting, Sand-Lime Brick Assn. Ellen Knight, sec., 321 N. Hamilton St., Saginaw, Mich.

Feb. 23-26, 1932. Wichita, Kan. Seventh Annual Southwest Road Show and School.

Feb. 23-26, 1932. Washington, D. C. Annual convention, American Concrete Institute, Wardman Park Hotel. Harvey Whipple, sec., 2970 West Grand Blvd., Detroit, Mich.

March 1-4, 1932. Washington, D. C. Twenty-eighth annual convention, American Concrete Institute. Harvey Whipple, secretary-treasurer, 2970 West Grand Blvd., Detroit, Mich.

Pumpings from the Old Pit

Excerpts from the old files of PIT AND QUARRY *reveal many interesting sidelights on the activities of the pits, quarries and plants of former days. These are printed in this column each issue.*

Fifteen Years Ago

THE American Sand & Gravel Co. was organized and a plant was in the process of erection at Pacific, Mo. The plant site, on the Meramec River, consisted of 200 acres of high quality sand-and-gravel deposits. Otto Bollman was president and the largest stockholder in the new concern. Associated with him was Jeff J. Prendergast, an experienced sand-and-gravel operator in the Pacific district.

* * *

An advantage possessed by a large gravel operator in a city in the middle west—that of having his plant located at an elevation considerably higher than the center of the town—was discussed editorially. His transportation costs being lower than that of a competing plant which was forced to make an up-hill haul, enabled him to sell his materials enough lower usually to outbid the competing concern.

* * *

Ten Years Ago

CONSTRUCTION was in progress at the new plant of the Pyramid Portland Cement Co. at Valley Junction, near Des Moines, Ia. Equipment included two 240-ft. rotary kilns, seven ball and tube mills, and a 36-in. gyratory crusher.

* * *

The Indiana Sand & Gravel Producers' Assn. set the dates of Jan. 10 and 11, 1922, for its next annual convention. The program committee consisted of J. A. Shearer, chairman, L. R. Witty and H. E. Neal. Dues of the association were to be placed on a tonnage-assessment basis and recommendations for such assessment were being prepared by a committee composed of James P. Coyle, chairman; G. J. Hoffman, J. A. Shearer, J. W. Bedford, and G. J. Nattkemper.

* * *

Ground was broken by the International Cement Co. at its Hudson, N. Y., plant for the erection of a new warehouse to cost approximately $200,000. The Turner Construction Co. of New York had the contract.

* * *

Incorporation of the Las Vegas Sand & Gravel Co., of Las Vegas, N. M., was announced at a capitalization of $25,000. Those identified with the new project were E. T. Springer, Cimarron, N. M.; James Collier, Denver, Colo.; C. Iden and C. Rosenwald, Las Vegas.

* * *

Five Years Ago

ADDITION of a third kiln at the plant of the National Cement Co. at Montreal brought its capacity to 3,000 bbl. per day. The plant began producing early in the year 1926 with two kilns. It was a dry-process operation.

* * *

The increased popularity of the hydraulic dredge and the outstanding developments in the dredging field were reviewed in an article by G. B. Massey.

A new sand-and-gravel plant with a capacity of 25 cars of washed and graded material per day was being erected at Elkhart Lake, Wis., by the Elkhart Sand & Gravel Co. Peter Kramer, plant superintendent, was directing the details of construction.

* * *

U. S. Patent No. 1,606,850 was granted W. S. Speed, president of the Louisville Cement Co. on a "method of and apparatus for utilizing heat from cement clinker."

New Corporations

MISSISSIPPI PORTLAND CEMENT CO., Jackson, Miss. Charter authorizes a capital stock of $1,500,000. Andrew Fitzpatrick (Barrone Bldg., New Orleans, La.), president and chairman of board; J. M. Evans (Jackson, Miss.), vice-president; B. R. Alford (Canal Bank Bldg., New Orleans, La.), director and engineer in charge of construction.

PINE MOUNTAIN STONE CO., Whitesburg, Ky. $15,000. L. M. Hart, J. D. Hart and W. M. Hart.

MANNING & LOCKLIN PONTIAC CO., 505 Lincoln Bldg., Detroit, Mich. John J. Manning, 80 Colorado Ave., Detroit, Mich.; Charles R. Locklin and William H. Manning, both of Highland Park, Mich. 12,558 sh. n.p.v. To produce, manufacture and sell sand, gravel, stone, etc. (Re-organization of Manning & Locklin.)

MANNING & LOCKLIN NORTHVILLE CO., 505 Lincoln Bldg., Detroit, Mich. John J. Manning, 80 Colorado Ave., Detroit, Mich.; Charles R. Locklin and William H. Manning, both of Highland Park, Mich. To deal in minerals, sand, gravel, etc. (Re-organization of Manning & Locklin.)

FLOYD MILLION & SON, INC., Lake Cicott, Ind. 500 sh. @ $100. Floyd Million, Jennie Million and W. F. Million. (Re-organization of the Million Sand & Gravel Co.)

CHAPMAN GRAVEL CO., Durand, Mich. $100,000. Edward Chapman, Durand, Mich.; Victor Mikan and James Steel, Jr., both of Swartz Creek, Mich.

TEXAS CRYSTAL CO., INC., Mineral Wells, Tex. F. C. Miller and G. F. Loske.

Motor-Truck Maker Gets Contract for 774 Units

What was said to be the largest single order for motor trucks placed since the World War was announced by the White Motor Co., Cleveland, O., on December 2 upon execution of a contract with the City of New York for 774 heavy-duty truck units.

The order involves an outlay of $2,600,000 and first deliveries are to be made by the first of the year.

Personal Mention

Col. Paul Weeks has been made manager of the Washington, D. C., office of the Caterpillar Tractor Co., according to a recent announcement by Pres. B. C. Heacock. **L. B. Neumiller** assumes the duties of service manager

Col. Paul Weeks.

L. B. Neumiller.

of the company to succeed Col. Weeks, who held the position for some time. **Lou Morgan** has been promoted to head of the parts department to succeed Mr. Neumiller.

Ed. W. Russell has been appointed sales manager of the Cumberland Portland Cement Co., succeeding the late J. Foster Cook, whose death occurred October 31. Assisting Mr. Russell will be **S. C. Gates, Frank Beasley** and **Robert Overton,** sales representatives, and **H. Frank Hughes,** traffic manager. Mr. Russell began his career in the cement industry in 1920 with the Atlas Portland Cement Co. at Birmingham, Ala. He served that company as district sales manager at Jacksonville, Fla., until 1926. In 1927 he became assistant sales manager of the National Cement Co. at Birmingham. During the past year and a half he has been connected with the Cumberland company.

Vint Gustin, foreman, **Fred Besco,** chemist, and **A. B. Claar,** commissary manager of the Superior, O., plant of the Wellston Iron Furnace Co., have been named as a committee for the organization of a Boy Scout troop from the eligible sons of workmen of the cement plant. The troop is being sponsored by the Methodist church of Superior. **George Henry,** attache of the plant office, will act as scoutmaster and **Ray Miller,** son of Robert Miller, plant repairman, will assist in the work.

J. B. Neel is reported to have closed negotiations which will enable him to establish a quarry on a 320-acre tract south of Big Springs, Tex., and will establish a lime kiln. Operations are scheduled to begin within ninety days.

Philip Weltner of Atlanta, Ga., has acquired 160 acres of kaolin lands in the western part of Washington County, near Sandersville, Ga.

H. W. Haapanen has been appointed district representative in the West Virginia mining territory by the Webster and Weller Mfg. Co. Mr. Haapanen is a mining engineer, widely known in the coal mining field, having been connected with the Fairmont Mining Machinery Co., and Consolidation Coal Co., and prior to that with Edgewater Coal Co. (subsidiary of Allied Chemical & Dye and Semet-Solvay Companies), West Kentucky Coal Co., and other prominent organizations in the mining regions. Mr. Haapanen is a graduate of Michigan College of Mines and a member of A. I. M. E. His headquarters will be in Charleston, W. Va.

E. C. Blum, vice-president of The Briar Hill Stone Co. of Millersburg, O., has been appointed by the Ohio Chamber of Commerce to serve on a committee to study the economics of business stabilization and unemployment. This special committee which is comprised of 28 of Ohio's leading business men will study existing conditions and suggest remedies for them. The committee will be asked to consider a proposed plan for unemployment insurance and make a report which will be forwarded to the governor's committee.

W. H. Stillhammer has been elected a member of the board of directors of the International Salt Co. to succeed the late Milo M. Belding.

A. A. Probeck has been appointed sales manager of the Federal Machine & Welder Co. of Warren, O. Mr. Probeck has had many years of experience in the welding field, having joined the C. & C. Co., one of the pioneer arc-welder manufacturers, back in 1910. Since 1912 he has been affiliated with the Federal company.

A. A. Probeck.

A. W. Thompson, who for the past five years has been Pacific coast manager in charge of sales for Fairbanks, Morse & Co., has been appointed vice-president in charge of manufacturing, according to an announcement made

H. W. Haapanen.

A. W. Thompson.

public by W. S. Hovey, president. Mr. Thompson succeeds Mr. Heath, who resigned November 1.

Sewell L. Avery, president of the United States Gypsum Co. of Chicago, has been elected chairman of the board of Montgomery Ward & Co., large mail-order concern, to succeed Silas H. Strawn, Chicago banker, who becomes chairman of the executive committee.

Louis H. Wismar, of Columbus, O., formerly surveyor for Sandusky county, who recently resigned as a division engineer in the Ohio state highway department, has been named manager of the Colprovia asphalt plant that was recently erected by the Wagner Quarries Co. near Sandusky.

L. W. Erickson was recently appointed to succeed **E. L. Parsons** as district representative on gears and speed reducers for the Milwaukee and Wisconsin territory by Foote Bros. Gear & Machine Co. of Chicago. Mr. Erickson is a mechanical engineer and brings with him a wealth of experience from years especially devoted to working with the industrial trade on problems involving the use of gearing and speed reducers. The territory was taken over by Mr. Erickson on November 1.

Obituary

Thomas A. Giberson, vice-president of the Cleveland Quarries Co., of Cleveland, O., passed away recently at his home at Lakewood, O. Heart disease was said to be the cause of death. Mr. Giberson is survived by the widow and one son. Burial was at Berea, O.

Recent Patents

AMERICAN

Cement

Method of making Portland cement. Adelbert C. Eichenlaub and Herman G. Loeffler, Des Moines, Ia. No. 1,832,192.

Crushing and Grinding

Grinding mill. Harlowe Hardinge, York, Pa., assignor to Hardinge Co., same place. No. 1,831,625.

Grinding mill. Ernst C. Loesche, Berlin-Lankwitz, Germany. No. 1,832,403.

Hammermill. Milton McMillan, Anaheim, Cal., and Robert S. MacMillan, Long Beach, Cal. No. 1,832,468.

Excavating

Extension boom for excavators. Augustus J. Penote, Shaker Heights, O. No. 1,832,787.

Lime

Device for slaking lime. Heinrich Spoerri, Zurich, Switzerland. No. 1,832,148.

Lime kiln. Robert T. Haslam, Belmont, Mass., assignor to Rockland & Rockport Lime Corp., Rockland, Me. No. 1,832,552.

Screening and Separating

Shaker sieve and method for producing the same. Rudolf Ferrmann, Dresden, Germany. No. 1,830,792.

Process and mechanism for separating, intermixed divided materials. Richard Peale, St. Benedict, Pa., assignor to Peale-Davis Co., Wilmington, Del. No. 1,832,048.

Shaking screen. William L. Wettlaufer, Buffalo, N. Y. No. 1,832,518.

FOREIGN

Cement and Concrete

Process and apparatus for preliminary treatment of raw material mixed for cement burning. J. S. Fasting. British 358,621.

Production of cement, lime or the like. A. Bues. British 359,080.

Mortar or concrete, and process of rendering cement, mortar and concrete watertight. Chemische Fabrik Grünau Landshoff & Meyer Akt.-Ges., assignee of Walter Kirchner, Grünau, Berlin, Germany. Canadian 317,233 and 317,234.

Hydraulic cement. Elias R. Wilner, New York City, N. Y. Canadian 317,401.

Crushing and Grinding

Pulverizers. Erie City Iron Works. British 358,521 and 358,522.

Grinding or crushing apparatus. T. Ketin. British 358,568.

Construction of grinding elements for roller grinding-mills. F. H. Rogers (Grinding Mixing Separating Engineering Co.). British 358,600.

Pulverizing apparatus. Clarke, Chapman & Co., Ltd., and W. A. Woodeson. British 359,231.

Mill for grinding material in a liquid or semi-liquid condition. A. Sonsthagen. British 359,484.

Grinding or crushing apparatus. Harold Sibree Rexworthy, Santa Ana, Cal. German 538,512.

Roller grinding mill. Firma F. Stille, Münster i. W. German 538,511.

Sieving ball-mill. Fried. Krupp Grusonwerk Akt.-Ges., Magdeburg-Buckau. German 538,708.

Apparatus for pulverizing solid materials. Maurice Madore, Alfort, Seine, France. Canadian 317,372.

Drilling

Feeding-devices for percussive tools. Ingersoll-Rand Co. British 358,790.

Valve for rock-drills. Ingersoll-Rand Co. British 359,779.

Well-drilling equipment. Roy Wilkins, San Francisco, Calif. Canadian 317,188.

Drying

Shaft drier for sand. Robert von Kalmann, Dusseldorf-Oberkassel. German 538,182.

Excavating

Excavating machine. Dr.-Ing. Otto Kammerer, Berlin-Charlottenburg. German 538,279.

Mechanical shovel. Joseph Boily, fils, St. Gregoire de Montmorency, Que. Canadian 317,402.

Reversible excavator tooth. American Manganese Steel Co., Chicago, Ill., assignee of Donald H. Young, Berkeley, Cal. Canadian 317,406.

Kilns

Rotary kilns for calcining cement and the like. F. Krupp Grusonwerk Akt.-Ges. British 359,277.

Lifter bars, blades, or the like for rotary kilns or drum furnaces. H. von Ferber. British 359,845.

Discharge device for trommels and rotary kilns. Fried. Krupp Grusonwerk Akt.-Ges., Magdeburg-Buckau. German 538,167.

Rotary kiln for the burning, calcining and sintering of materials. Berthold Lange, Hannover. German 538,425.

Apparatus for burning cement. Fried. Krupp Grusonwerk Akt.-Ges., Magdeburg-Buckau. German 538,531.

Closure of upper end of rotary kiln. Arno Andreas, Münster i. W. German 538,426.

Rotary kiln for burning cement and the like. Harry Stehmann, Berlin-Südende. German 538,625.

Exhaust-gas discharge from rotary kiln. Arno Andreas, Münster i. W. German 538,973.

Process and apparatus for feeding pulverized or slurry-like raw materials into rotary kilns by means of compressed air. Arno Andreas, Münster i. W. German 538,750.

Lime

Lime-slaking machines. E. J. Shaut, H. R. Baker and P. S. Dickinson. British 359,853.

Material-Handling

Drive-mechanism for conveyor belts. A. E. White (Robins Conveying Belt Co.). British 358,581.

Means for delivering finely-divided or powdered material to conveyors. Steel Band Conveyor & Engineering Co., Ltd., and W. H. Allen. British 358,678.

Method and apparatus for conveying plastic material. Goodyear Tire & Rubber Co. British 358,693.

Automatic weighers applied to conveyors. S. C. Brown. British 358,786.

Systems for conveying fine-grained materials by compressed air. F. L. Smidth & Co., Ltd. (F. L. Smith & Co. Aktieselskab). British 358,860.

Concrete and the like conveyors. W. L. Stone and Hume Pipe & Concrete Construction Co., Ltd. British 359,086.

Hydraulic conveying system for use in mines. J. Brown. British 359,515.

Shaking-trough conveyor. Tom Briggs Wilkinson, Blackston, England. German 538,533.

Scraper conveyor. Haukines Maschinenfabrik, G. Hausherr, E. Hinselmann & Co., G. m. b. H., Essen. German 538,974.

Sacking

Paper bags. H. Jackson. British 358,696.

Bag corner sewing and like operations. British United Shoe Machinery Co., Ltd., F. Ricks and A. E. Richards. British 359,403.

Bags for cement and other commodities. W. A. Merrick. British 359,723.

Machines for filling and closing bags. F. Hesser Maschinenfabrik Akt.-Ges. British 359,781.

Sack-closing device. Herfurth & Heyden Drahtheftmaschinenfabrik m. b. H., Leipzig. German 538,171.

Device for regulating the flow of material in bag-filling machines. Dipl.-Ing. Johannes Gravenholt, Berlin-Neukölln. German 538,267.

Paper bag. Bates Valve Bag Corp., Chicago, Ill., assignee of Edgar Hoppe, Berlin, Germany. Canadian 317,207.

Screening and Separating

Separation of dry materials. I. L. Bramwell and Birtley Co., Ltd. British 358,986.

Sieve brushes. H. Simon, Ltd., and H. A. Bagg. British 359,745.

Separation of pulverulent materials. N. Ahlmann. British 359,763.

Screening or separating apparatus. Curt von Grueber Maschinenbau Akt.-Ges., Berlin. German 538,136.

Dust separator. Ernst Ludwig, Belten i. d. Mark. German 538,137.

(Continued on page 74)

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Traffic News and Comment

Examiners' Reports

Crushed Stone.—Examiner T. Naftalin proposes that the Interstate Commerce Commission find the rates assessed on crushed limestone from Krause, Ill., to Capleville, Tenn., applicable and not unreasonable and dismiss the complaint. I. C. C. Docket No. 24,606, Shelby County Commissioners *v.* M. P. et al.

Lime.—Examiner Carl A. Schlager proposes that the Commission find the rate on bulk lime from Mosher, Mo., to Charleston, S. C., not unreasonable and dismiss the complaint. I. C. C. Docket No. 24,595, Phosphate Products Corp. *v.* Mo.

New Complaints Filed

Cement.—Unreasonable charges in violation of Sections 1 and 15 on Portland cement from Ada, Okla., to points in Louisiana and Arkansas are complained of and reparation is sought in I. C. C. Docket No. 24,805, Oklahoma Portland Cement Co., Denver, Colo., *v.* K. C. S. et al.

The same allegations as above with prayer for reparation are being handled under I. C. C. Docket No. 24,805 Sub. No. 1, Oklahoma Portland Cement Co., Denver, Colo., *v.* A. T. & S. F. et al.

Rates and charges in violation of sections 1 and 6 are alleged on cement from Humboldt, Kans., to Sumner, Okla., and complainant asks cease and desist order and reparation in I. C. C. Docket No. 24,843, Monarch Cement Co., Humboldt, Kans., *v.* A. T. & S. F. et al.

Crushed Stone.—Unreasonable rates on crushed stone from Greenfield, Mass., to Petersburg, N. Y., are alleged and new rates and reparation prayed for in I. C. C. Docket No. 24,830, Kelleher Corp., Turners Falls, Mass., *v.* B. & M. et al.

Fluxing Stone.—New rates on crude, fluxing, foundry or furnace limestone from Stephens City, Md., to points in Maryland, Pennsylvania, West Virginia, Ohio and Delaware on a complaint of present rates violating Sections 1 and 3, shippers at Thomasville and Williamson, Pa., and Engle and Martinsburg, W. Va., and other nearby producing points preferred. I. C. C. Docket No. 24,823, M. J. Grove Lime Co., Lime Kiln, Md., *v.* B. & O.

Ground Limestone.—Rates on ground or pulverized limestone from Mascot, Tenn., to points in North Carolina, South Carolina, Tennessee, Kentucky, Virginia, Georgia, Mississippi, Louisiana, Arkansas and Florida are alleged to be in violation of Sections 1, 3 and 13 as compared with rates from points in Illinois and Kentucky, and as compared with intrastate rates in Kentucky, Georgia, Mississippi, Virginia and North Carolina and on marl in North Carolina. Rates and reparation are sought, I. C. C. Docket No. 24,820, American Limestone Co., Knoxville, Tenn., *v.* A. & R. et al.

Ground Limestone and Agricultural Lime.—Prejudicial rates in violation of Section 3 on ground or pulverized limestone and agricultural lime from Bittinger, Pleasant Gap, Blue Bell and other points in Pennsylvania to destinations in New Jersey, Delaware, Maryland, Virginia and West Virginia, with shippers at Martinsburg, Engle and Millville, W. Va., preferred are alleged. Complainant asks cease and desist order and rates for the future. I. C. C. Docket No. 24,432, Sub. No. 2, The Warner Co., et al., DeVault, Pa., *v.* A. C. et al.

Talc.—Rates in violation of Sections 1 and 3 on talc from Hailesboro, N. Y., to points in New Jersey, Pennsylvania, Maryland, Delaware, District of Columbia, Ohio, Indiana, Illinois, Michigan, West Virginia, Virginia, Massachusetts, Maine, New Hampshire, Vermont, Rhode Island and Connecticut, as compared with rates from Hemp, N. C., Canton, Ga., various New England points and other origins are alleged and new rates sought in I. C. C. Docket No. 24,848, International Pulp Co., New York, N. Y., *v.* N. Y. C. et al.

Sand and Gravel.—Rates on sand and gravel in violation of Sections 1, 3 and 13, from Elizabethton, Tenn., to points in Virginia as compared with rates from Petersburg, Va., are alleged and new rates and reparation sought in I. C. C. Docket No. 24,840, East Tennessee Sand and Gravel Co., Elizabethton, Tenn., *v.* Southern et al.

Unreasonable rates on sand and gravel from Carpenterville, N. J., to Sandts Eddy, Pa., are charged and rates and reparation sought in I. C. C. Docket No. 24,850, B. G. Coon Construction Co., Luzerne, Pa., *v.* Pennsylvania et al.

Rate-Committee Dockets

New England Freight Assn.

Crushed Stone.—To meet motor-truck competition, shippers propose that the rate on crushed stone[1], from Westfield, Mass. (Hampden Quarry), to Millville Heights, Mass., be reduced from $1.35 to $1.10 a net ton. Docket No. 23,783.

Trunk Line Assn.

Crushed Stone.—To meet competition at Schoharie, N. Y., shippers at Oriskany Falls, N. Y., propose that the rate on crushed stone[1], to Sidney, N. Y., be reduced from 91 c. to 75 c. per net ton. Docket No. 28,046.

Fluxing Stone.—Shippers at Billmyer, Pa., are asking for the establishment of the same rates and same minimum weights on fluxing stone as now apply from Bainbridge, Pa. Docket No. 28,080.

Ground Limestone.—Increases in rates on ground limestone, c.l. min. wt. 50,000 lb., from Jamesville, N. Y., to stations on the D. & H. Rates are shown per net ton. Docket No. 28,082.

To	Proposed	Present
Harpursville to Afton, N. Y., inclusive	$1.71	$1.65
Bainbridge to Colliers, N. Y., inclusive	1.83	1.65
Maryland, N. Y.	1.96	1.65
Hyndsville to Sharon Springs, N. Y., inclusive	2.20	2.10
Cherry Valley, N. Y.	2.21	2.10
Howes Cave to Delanson, N. Y., inclusive	2.20	2.10
South Schenectady, N. Y.	2.21	1.65
Schenectady to Troy, N. Y., inclusive	2.21	1.65
Lansingburg, N. Y.	2.34	1.65
Cohoes, N. Y.	2.21	1.65

Lime.—Carriers propose to establish a rate of 24½ c. on building, agricultural and chemical lime, c.l. min. wt., 30,000 lb., from B. & O. Martinsburg and Strasburg groups to N. Y. C. R. R. stations, Dunwoodie to Tilly Foster, N. Y. Docket No. 27,914, Sup. 1.

Marl.—Shippers propose a reduction in the rate on ground marl, c.l. min. wt. 50,000 lb., from Charles Town, Alba-Marl Lime Co., Natural Lime Marl Co., Siding, W. Va., to Sharpsburg, Pa., from 17 c. to 12½ c. per 100 lb. Proponents claim this rate is comparable with rates on agricultural lime from Charles Town to Pittsburgh district. Docket No. 28,045.

Plaster.—Carriers propose the establishment of the rates shown in Column A below on plaster and related articles, and the rates shown in Column B on plasterboard to Johnstown, N. Y. Rates 2 c. above those shown are to apply to Gloversville and Broadalbin, N. Y. Rates shown are in cents per 100 lb. Docket No. 27,885, Sup. 2.

From	A	B
Harrison, N. J.	18½	20½
Newark, N. J.	18½	20½
Knickerbocker, Pa.	20	22
Rambo, Pa.	20	22
Blue Bell, Pa.	20	22
Devault, Pa.	20	22
Harrisburg, Pa.	20½	22½
York, Pa.	20½	22½
New Brighton, N. Y.	18½	20½
Carteret, N. J.	18½	20½
Jersey City, N. J.	18½	20½
Elizabethport, N. J.	18½	20½
Garbutt, N. Y.	17	19
Wheatland, N. Y.	17	19

Sand and Gravel.—To meet truck competition carriers propose to reduce the rate on sand and gravel[1], from Sherburne Four Corners, N. Y., to Hancock, N. Y., from $1.00 to 80 c. a net ton. Docket No. 28,047.

To meet motor truck competition shippers propose a reduction in the rate on sand and gravel[1], from Susquehanna, Pa., to Forest City, Pa., from 70 c. to 65 c. a net ton. Docket No. 28,094.

Sulphur.—Shippers propose the following rates on sulphur (brimstone), crude, unground or unrefined, c.l. min.

wt. 60,000 lb., to Charleston and South Charlestown, W. Va., from Baltimore and Hampton Roads Ports 25 c.; from Wilmington, Del., and Philadelphia, Pa., 26 c.; and from New York, N. Y., 28 c. per 100 lb. Docket No. M-1,906.

Central Freight Assn.

Crushed Stone.—Carriers propose to reduce the rate on crushed stone from Greencastle, Ind., to Campbellsburg, Ind., from $1.15 to $1.00 per net ton. Docket No. 29,811.

A reduction in the rate on crushed stone from Piqua, O., to Ottawa, O., from 13½ c. per 100 lb., to 90 c. per net ton is proposed by shippers. Docket No. 29,897.

Carriers propose publication of commodity rates on crushed stone from Putnamville, Ind., to Lewis, Black Hawk of 98 c.; to Blanford, Bradshaw and West Clinton, Ind., of $1.13 per net ton. Class rates now apply. Docket No. 29,901.

Sand and Gravel.—A reduction in the rate on sand and gravel from Terre Haute, Ind., to Petersburg, Ind., from 95 c. to 80 c. per ton to expire Nov. 1, 1932, is proposed by shippers. Docket No. 29,872.

Establishment of a commodity rate of $1.00 per ton on sand and gravel to Paoli, Ind., from Rockport, Tell City and Cannelton, Ind., and of $1.05 from Evansville, Ind., is proposed by shippers. Class rates now apply. Docket No. 29,881.

Illinois Freight Assn.

Sand and Gravel.—Reduced rates on common sand and gravel[1], are proposed to apply from Mt. Carmel, Ill., to the following destinations on the Southern Rwy. Rates shown are in cents per net ton. Docket No. 6,358.

To	Present	Proposed
Browns, Ill.	65	60
Albion, Ill.	65	60
Ellery, Ill.	65	60
Golden Gate, Ill.	65	60
Merriam, Ill.	76	65
Fairfield, Ill.	78	65

Western Trunk Line Committee

Agricultural Limestone.—It is proposed by shippers to add Rock Hill, Mo., a local point on the Mo. Pac., as a point of origin in Item 1,105-H of Western Trunk Line Tariff 91-F. Docket No. 7,383-C.

Shippers are proposing a mileage scale of rates to apply on ground or pulverized agricultural limestone, in bags, barrels or in bulk[1], from St. Joseph, Mo., to stations on the C. R. I. & P. in Iowa. Some points on this scale carried under Docket No. 496-S are,

Miles	Rate	Miles	Rate
50	63	300	165
100	88	400	195
200	135	500	225

Cement.—It is proposed to reduce the rate on cement from Louisville, Neb., to Omaha, Neb., to apply on intrastate traffic only, from 8 c. applying on a c.l. min. wt. of 50,000 lb., to 6 c. on a c.l. min. wt. of 80,000. A shipper's proposal. Docket No. 6,549-D.

Lime.—It is proposed to reduce the rate on lime, c.l. min. wt. 30,000 lb., from Quincy, Ill., to Marshall, Mo., from 26 c. (Class C) to 12½ c. per 100 lb. Docket No. 7,753.

Mortar.—Shippers propose that the rates which now apply on lime from Cordova, Ill., be amended to also apply on dry building mortar in straight carloads or in mixed cars with lime, c.l. min. wt. 30,000 lb., except when the c.l. min. wt. on lime is 50,000 lb., the same minimum will apply on mortar. Docket No. 7,197-A.

Southern Freight Assn.

Cement, Lime and Plaster.—Carriers propose to amend the Note at present shown in connection with Item 62 of Note "A" of Exceptions to Southern Classification, Agent Dulaney's I. C. C. No. 40, to read as follows: "Shipments of mixed carloads of cement, lime and/or plaster (comprising a mixture of any two or more of these commodities), will be taken, subject to the highest carload minimum weight applicable on any commodity included in the mixture. The carlcad rate will be charged on the actual weight of each commodity, and deficit necessary to make up the required minimum weight to be charged for at the highest rate assessed on any of the commodities included in the mixture. Alternating rates on lime, carloads, are generally in effect, such rates applying on minimum weights of 30,000 lb., or 50,000 lb. Where the total weight of the commodities in the mixture is less than 40,000 lb., the higher carload rate on lime will be applied to the actual weight of the lime contained in the shipment. Where the total weight of the commodities in the mixture is 40,000 lb., or more the lower carload rate on lime will be applied to the actual weight of the lime contained in the shipment. In no case shall the total charge on any shipment be less than the highest minimum carload charge on any article contained in the shipment when in straight carloads. Docket No. 56,130.

Mica.—Shippers propose 17½ per cent. of first class as a basis for rates on scrap or waste mica, c.l. min. wt. 60,000 lb., from Black Mountain Railway stations (Bowditch, N. C.) to Rutherford, N. J., 32 c. and to Forest Park, Ill., 35 c. per 100 lb. The present rate to Rutherford is 74 c. and to Forest Park is 80 c. per 100 lb. Docket No. 55,859.

Mica.—Shippers at Balsam, N. C., propose a line of rates on dry ground mica, c.l. min. wt., 50,000 lb., to Ohio and Mississippi River crossings and points in S. F. A., C. F. A., I. F. A., N. E. F. A., and T. L. A. territories, made with relation to rates from Biltmore, N. C. Statement of the proposed rates will be furnished on request. Docket No. 56,011.

[1] The carload minimum weight will be 90 per cent. of the marked capacity of the car except when car is loaded to full cubical or visible capacity actual weight will apply.

Recent Patents

(Continued from page 72)

Electrical-precipitation apparatus. International Precipitation Co., Los Angeles, Cal. Canadian 317,275 (assignee of Harry V. Welch, Los Angeles), 317,276 and 317,277 (assignee of Wilhelm Hoss, Frankfurt a/M., Germany) and 317,278 (assignee of Franz Seipp, Frankfurt a/M., Germany).

Unclassified

Securing pins in dredger buckets, conveyor buckets or links, endless-track mechanisms, and the like. J. S. Whittaker and H. E. Barrett. British 358,598.

Mining props. L. F. Gerdetz. British 358,904.

Sound-insulated buildings. A. A. Thornton (United States Gypsum Co.). British 358,941.

Pit props. S. F. Sopwith and M. J. Foggo. British 359,185.

Steel or metal mesh for reinforcing concrete, asphalt, and like material. A. P. Gupwell. British 359,322.

Slag-handling apparatus. F. B. Allen. British 359,406.

Method of and apparatus for treating molten slag and like material. Ash Co. (London), Ltd., and P. B. Silk. British 359,405.

Process for producing a mortar-thickening material out of beef-tallow and lime. Christian Heisch, Saarbrücken. German 538,069.

Rock-wool producing apparatus. Edward R. Powell, Alexandria, Ind. Canadian 317,381.

Lack of Capital Forces Co. to Decline Contract

Lack of only about $15,000 working capital for necessary additional equipment was said to have forced the Blair Granite Co. of Ashland, Ore., to decline a $215,000 contract for furnishing granite for the construction of a post-office building at Salt Lake City, according to press reports.

The company had submitted the low bid for the job and had been awarded the contract but was unable to raise the necessary funds for re-equipping its plant, it was said.

Appoints Marietta Firm as Distributor in Ohio

Chain Belt Company, Milwaukee, Wis., recently appointed the Ohio Valley Machinery Co. of Marietta, O., as our new distributor in eastern Ohio. The firm will handle a complete line of mixers, pavers, pumps, central-mixing plants, truck mixers and other construction equipment.

Diamond drilling has been started on the quarry of the Vertique Marble Co., a few miles northwest of Ishpeming, Mich. The work is being done by the contract department of the Sullivan Machinery Co., Chicago.

Financial News

The information contained in these financial pages is given with the understanding that any statement on the part of this magazine or any of its staff, as to the responsibility or standing of any person, firm or corporation, or as to the value of any property or securities is a mere expression of opinion, given as a matter of service to the readers of PIT AND QUARRY, *for which no responsibility in any way is to attach to this magazine or to any of its staff.*

Arundel Corp. Earnings Maintain Stable Trend

Arundel Corp. of Baltimore, Md., reports for ten months ended October 31, 1931, net profit of $2,001,946 after depreciation, federal taxes, etc., equivalent to $4.04 a share on 495,556 no-par shares of capital stock. This compares with $2,290,994 or $4.62 a share in the first ten months of 1930.

October net profit was $267,558 after taxes and charges, against $333,893 in October, 1930.

Current assets on October 31, last, were $4,310,409 and current liabilities $474,492.

International Salt to Net About $4 per Share

Net profit of International Salt Co. and subsidiaries for the year should equal around $4 a share on the 240,000 no-par shares now outstanding. The company ordinarily earns about 60 per cent. of its net in the last half of the year, and it is likely that that ratio will be maintained this year. Last year, due to the non-recurring administrative and legal expenses, the net was lower in the second half than in the first.

Acquisition by International of Sterling Salt Co. in the summer of 1930 has made possible savings in both mining and distribution. Salt as a commodity is not subject to wide price variations.

International Salt Co. at present has a strong current position, which is not materially different from that at the end of 1930, when ratio of current assets to current liabilities was about 4½ to 1.

The company and subsidiaries reported for six months ended June 30, 1931, profit of $399,320 after interest charges, but before bond sinking fund and federal taxes, comparing with $366,951 in the first half of 1930. Capital stock outstanding amounts to 240,000 no-par shares. The company does not issue quarterly reports.

For the year ended December 31, 1930, International Salt and subsidiaries reported net income of $679,480 after taxes, interest, depreciation and depletion, equivalent to $3.23 a share on average number of shares outstanding during the year and to $2.83 a share on the 240,000 shares outstanding at the end of the year. This compared with $687,767, or $11.32 a share (par $100) earned on 60,771 shares in year ended December 31, 1929.

In July, this year, the company acquired Independent Salt Co. of New York City, through purchase of its capital stock. Independent Salt is the oldest and largest merchandising concern in the metropolitan district, with warehouses located at waterfront points, and includes in its distribution the "Red Cross" brand of table salt in cartons. International, in acquiring Independent, strengthened its position in the greater New York market, enabling the company to render better service by closer contact and dealing more directly with the trade.

The company, in the summer of 1930, recapitalized, effecting a three-for-one split up and further increasing the number of shares to the 240,000 at present outstanding through issuance to stockholders of rights to subscribe to new stock, at $36 a share, in ratio of one share for each three shares held. Proceeds from the stock offering were used toward financing the purchase of Sterling Salt Co. for a cash payment of $2,000,000. Both International and Sterling were mining the same rock salt vein at Retsof, N. Y., on adjoining properties, and this acquisition by International made possible the effecting of appreciable economies in the mining and selling of salt.

Based upon the present $3 annual dividend rate, the indicated yield on the stock at present quotations is around 10 per cent. The issue is selling about 10 times the company's 1930 earnings, based on the average number of shares outstanding during the year.

The company has declared the regular quarterly dividend of 75 cents, payable January 2 to stock of record December 15.

National Gypsum Co. to Pay Preferred Dividend

The National Gypsum Co. of Buffalo, N. Y., has declared the regular quarterly dividend of $1.75 on the preferred stock, payable January 2 to stock of record December 15.

Concrete Beams, Columns Cast for Home Building

While advocates of steel, lumber, brick and concrete block for use in home construction argue the merits of their respective materials, a third entry in the competition for the supplying of building materials for American homes has appeared. This is factory-fabricated concrete beams and columns for fitting at the building job.

A. E. Pearson and B. F. Brice, long connected with the building industry in Chicago, have developed a method for the manufacture of concrete beams, columns and other parts for use in the building of homes and small apartment houses. They have organized the Brice-Pearson Corp. and now have a plant producing these products near Chicago.

Among the advantages claimed for this new method of building is that it permits concrete construction the year around. Further, it is claimed that a uniformity of products is possible through controlled manufacture which is not always attainable where concrete is poured on the job by unskilled workmen.

The Brice-Pearson plant produces roof slabs, floor slabs, columns, beams, wall slabs and other sections required in building construction. It is asserted that the cost is only slightly in excess of that arising from non-permanent methods of building homes.

A number of homes and apartments have already been erected under the Brice-Pearson method.

CURRENT DIVIDENDS

COMPANY	CLASS OF STOCK	DIVIDEND RATE	HOLDERS OF RECORD	PAYABLE	COMPANY	CLASS OF STOCK	DIVIDEND RATE	HOLDERS OF RECORD	PAYABLE
Alpha Portland Cement	Preferred	$1.75 qr.	Dec. 1	Dec. 15	Pittsburgh Plate Glass	Common	$0.25 qr.	Dec. 10	Dec. 31
Canada Cement Co	Preferred	$1.62¼ qr.	Nov. 30	Dec. 31	Raybestos-Manhattan	Common	$0.40 qr.	Nov. 30	Dec. 15
Cleveland Quarries Co	Common	$0.25 qr.	Nov. 10	Dec. 1	Republic Portland Cement	Preferred	$1.75 qr.	Nov. 23	Dec. 1
Giant Portland Cement	Preferred	$1.75 S A.		Dec. 15	Schumacher Wallboard	Preferred	$0.50 qr.	Nov. 5	Nov. 15
International Amiesite	Preferred	$1.75 qr.	Nov. 20	Jan. 1	Southwestern Portland Cement	Preferred	$2.50 qr.		Jan. 1
International Salt	Common	$0.75 qr.	Dec. 15	Jan. 2	Southwestern Portland Cement	Common	$1.50 qr.		Jan. 1
Johns-Manville	Common	$0.25 qr.	Dec. 26	Jan. 15	Superior Portland Cement	Class A	$0.27½M	Dec. 23	Jan. 1
Kentucky Rock Asphalt	Preferred	$1.75 qr.	Dec. 10	Jan. 2	Texas Gulf Sulphur	Common	$0.75 qr.	Dec. 1	Dec. 15
Lehigh Portland Cement	Preferred	$1.75 qr.	Dec 14	Jan. 2	United States Gypsum	Common	$0.40 qr.	Dec. 15	Dec. 31
McWilliams Dredging	Common	$0.37½ qr.	Nov. 15	Dec. 1	United States Gypsum	Preferred	$1.75 qr.	Dec. 15	Dec. 31
Monolith Portland Cement	Preferred	$0.40 S.A.		Jan. 2	Warner Co	1st Pfd.	$1.75 qr.	Dec. 15	Jan. 1
Monolith Portland Cement	Common	$0.40 S.A.		Jan. 2	Warner Co	2nd Pfd.	$1.75 qr.	Dec. 15	Jan. 1
National Gypsum Co	Preferred	$1.75 qr.	Dec. 15	Jan. 2	Worcester Salt	Preferred	$1.50 qr.	Nov. 9	Nov. 16

Review of Foreign Practice

Swiss Cement Mill Uses Shaft and Rotary Kilns

A cement plant built in 1928 and 1929 at Hausen near Brugg in the canton of Aargau, Switzerland, utilizes the abundant and excellent raw materials of the Jura region, and has an initial capacity of 500 metric tons daily, which can be increased to 1,000 by installing duplicate units in spaces provided in the original design. The plant is equipped with both rotary and shaft kilns, partly with the idea of running easily at partial capacity when market conditions require, and partly to take advantage of the lower first costs and operating costs of the shaft kiln.

The raw materials are a hard Jura limestone of high calcium-carbonate content and different Jura lime-marls, which reach the plant in railway cars. These materials are dumped by a rotary car-dumper and are fed to a large hammer-mill which produces the required 800 metric tons daily in 8 hr. of operation. The crushed stone is dried in a rotary drier, and is ground in a compound mill 2.2 (88 in.) meter in diameter and 14 meters (46 ft.) long, which delivers 60 tons hourly, so that the 24-hr. requirements are met during night operation at the low night rates for electricity. All units of the plant except the kilns are so planned. The raw material is then thoroughly mixed in special bins and distributed to the kilns. These consist of two Andreas automatic shaft kilns, 8 ft. 4 in. in diameter and 33 ft. 4 in. in height, and one dry-process rotary kiln, 9 ft. 4 in. in diameter and 150 ft. long, followed by a special cooler. The clinker is ground in two mills, which are of the same type and dimensions as the raw-grinding mill and are housed in the same building. Packing is done by automatic valve-baggers. The plant is so thoroughly mechanized that only 18 men are required per shift. Another feature is the fact that the cement from the shaft kilns shows a quality well above the strict Swiss standards. The plant was designed, built and equipped by the Andreas Co., of Münster, which later turned over its cement department to the F. Krupp Grusonwerk Akt.-Ges.—Oberingenieur Friedrich Tippmann in *Tonindustrie-Zeitung* 55:872-875, July 27, 1931.

Protecting Concrete by Sprayed-Metal Coatings

In a 16-month investigation of the effect of spraying concrete with metal, cubical specimens were protected: (a) by a coating of a standard naphtha-soluble bituminous product, applied in three coats with a brush; (b) by a sprayed coating of zinc; (c) by a 3-coat spraying of lead; and (d) by a 5-coat spraying of lead. They were stored 16 months in: (1) a 5-per cent. hydrochloric-acid solution; (2) a 5-per cent. ammonium-sulphate solution; and (3) a 10-per cent. magnesium-sulphate solution. The compressive strengths at the end of this period, in kg. per sq. cm., were:

	5% H Cl	5% $(NH_4)_2SO_4$	10% $MgSO_4$
Unprotected	3	28	96
Bitumen-coated	95	138	337
Zinc-sprayed	—	352	290
Lead-sprayed, 3 coats.	53	326	—
Lead-sprayed, 5 coats.	78	386	—

Comparison of the surfaces of the various specimens made some interesting conclusions possible. Bitumen coatings properly applied give considerable protection even against free acids and salt solutions, and what destruction occurs takes place obviously at thin spots, through which the fluid enters. Even thick coatings can be destroyed by diffusion and the formation of bubbles when the liquids force through the coating according to the laws of osmotic pressure. Sprayed metal coatings protect the concrete, especially against salt solutions but also against free acids. The protection could undoubtedly be increased by smoothing the concrete surface before spraying the metal coating.—Prof. Dr. R. Grün in *Zement* 20:855-858, Sept. 17, 1931.

Japan's Cement Industry from a German Viewpoint

As an industrialized country Japan has a great cement-consuming capacity, which was stimulated particularly by the 1923 earthquake disaster. The earthquake gave only temporary encouragement to cement of foreign production, however, and the Japanese cement market today is supplied almost exclusively by Japan's own cement plants. In other countries in the Orient, however, Japan is not as yet a serious competitor, as the domestic demand takes almost all of the domestic production. Japanese exports have even gone down in recent times because of more favorable sales conditions at home. The Japanese cement industry has not escaped some effects from the depression which is worldwide, but through improvements in mechanical efficiency, through consolidations and through safeguards of the credit basis the industry has improved itself and prices have risen. Some new plant construction has taken place this year.—Dr. E. Barth in *Zement* 20:897, Oct. 1, 1931.

Suitability of Magnesite in Lining Cement Kilns

In view of the difficulties connected with refractory lining material for cement kilns it is surprising that so little attention has been paid to magnesite. Magnesite generally contains over 90 per cent. of the strong base MgO, which never reacts as an acid as alumina sometimes does, and thus meets the prime requirement of basicity in order not to react with the material being burned. Magnesite blocks of good quality are also highly resistant to wear, as its almost exclusive use in metallurgy shows. It is true that magnesite is sensitive to changes in temperature, but this ordinarily is of no consequence as the kiln runs without interruption as long as the lining lasts; at least, shutdowns are never likely to be frequent enough to be of particular damage. Price has in the past been one objection, but magnesite prices, like others, are going lower. A bigger objection than price, however, has been the fear that the magnesia that does wear off the lining will make the cement unsound. It has been established, however, that well-sintered magnesite under normal conditions is no longer capable of reacting with the cement; a series of tests over a 5-yr. period show that even in percentages of 2 and 5—thus much higher than would conceivably occur—did not interfere with the quality of the cement, either in hardening, soundness, or strength. —Dr. K. A. Goslich in *Tonindustrie-Zeitung* 55: 108101082, Sept. 24, 1931.

Heating of Aggregates Called Best Protection

A summary of recent investigations on the protection of concrete against freezing shows that although it is preferable at times of great cold to interrupt concreting of works in which a comparatively large surface is exposed, these can nevertheless be concreted in security if the aggregates and mixing water are heated to a temperature of at least 30 deg. C. before entry into the mixer, so that the concrete can be placed at from 20 to 25 deg. This preheating can be accomplished on the job by means of steam tubes through the piles. In each case there should be a preliminary investigation to determine the temperature to which the aggregates and water should be heated so that the concrete will be put in place at around 20 deg. Aside from this preheating, all methods considered seem inefficient and involve useless expense, particularly for jobs of any size.—*Le Ciment* 36:307-311, Sept., 1931.

Manufacturers' Publications

Each publication listed below contains information of interest to non-metallic mineral producers. Readers may obtain, without charge—except where a price may be stated—and without obligation, copies of any of these publications by writing directly to the manufacturers who publish them. Please mention PIT AND QUARRY *when writing.*

Building and Engineering

101 Questions That Should Be Answered Before You Build. 12 p. (The Austin Co., Cleveland, O.) While intended primarily to help the executive who is face to face with a building project, the booklet also raises questions, the answers to which are important to executives who have building operations farthest from their minds.

Crushers

TZ and BH Reduction Crushers. 2 p. (The Traylorian for November-December, 1931. Traylor Engineering & Manufacturing Co., Allentown, Pa.) Describes and illustrates two crushers manufactured by this company. *The Traylorian* is a new house organ, this being its first issue. It will be mailed regularly on request on application direct to the company.

Drilling

"Steel Drill Sets New Record." 2 p. (*The Armstrong Driller* for October-November, 1931. Armstrong Manufacturing Co., Waterloo, Ia.) Describes and illustrates the performance of an all-steel well drill at a large eastern trap-rock quarry where 70 ft. of 8-in. hole was opened in a 10-hr. shift.

Electrical Equipment

CR1062 Motor-Starting Switch. 4 p. (Bull. GEA-1522. General Electric Co., Schenectady, N. Y.) Describes and illustrates a manually-operated, three-pole motor-starting switch with temperature-overload protection.

Lubrication

"Lubrication Requirements of Air, Refrigeration and Gas Compressors." 12 p. (*Lubrication* for November-December, 1931. The Texas Co., New York, N. Y.) A condensed treatise on lubricating all types of compressors that should be in the files of every operating man.

Metals

Gears Made of Armor Plate. 8 p. (The International Nickel Co., Inc., New York, N. Y.) Describes and illustrates the story of nickel-steel gears and pinions and their successful performance, particularly in the automotive industry.

Diamite—the Iron with the Super Chill. 4 p. (Weatherly Foundry & Manufacturing Co., Weatherly, Pa.) Describes an alloy white iron of great hardness (650 to 725 Brinell) for castings in which strength and high resistance to abrasion are prime requirements.

Power Transmission

"Redesigning Your Drives." 3 p. (*The Houghton Line.* Vol. 1, No. 4. E. F. Houghton & Co., Philadelphia, Pa.) Describes the increased transmission efficiency of a short-center leather belt drive and undertakes to show how its replacement for standard drives will result in greater operating economy.

Pumps

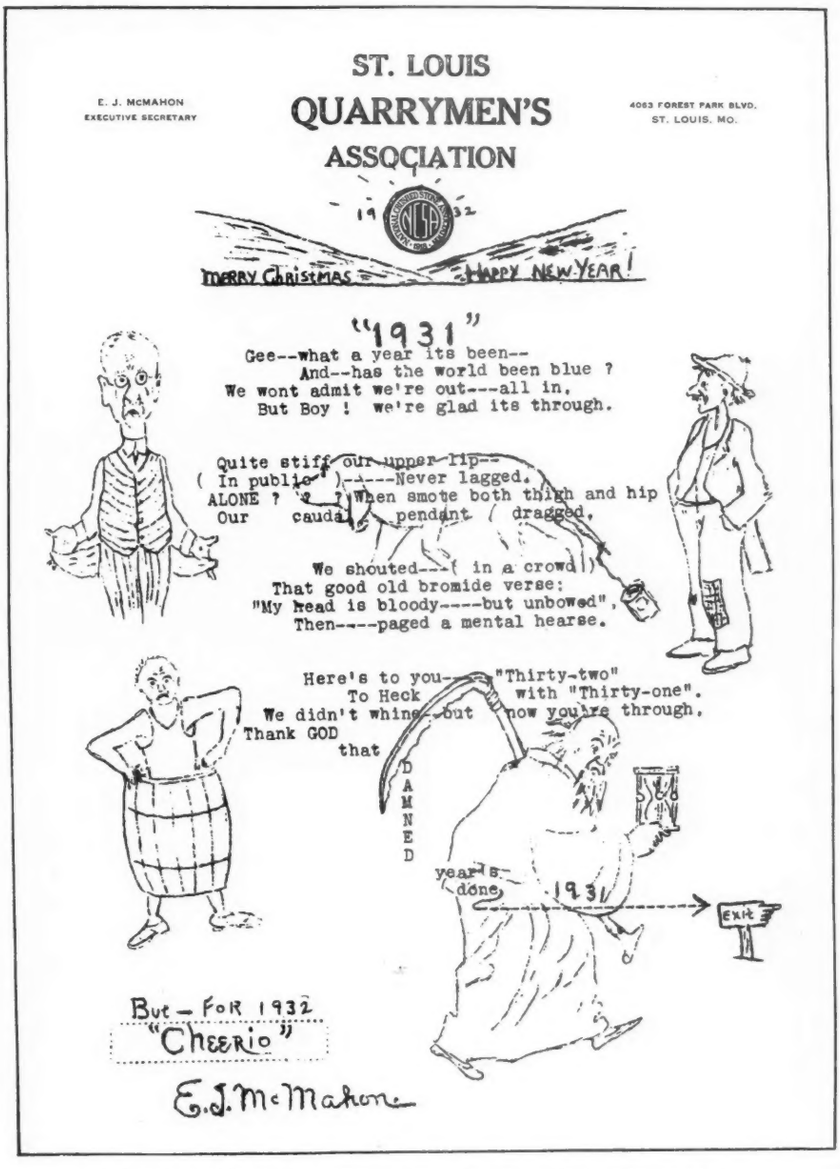
Deming Vertical Single-Acting Power Pumps. 8 p. (The Deming Co., Salem, O.) Describes and illustrates a line of vertical, single-acting piston pumps for general service, handling from 4.65 to 18 gal. per min.

Class LS Single Stage Centrifugal Pump. 8 p. (Bull. No. 217. Pennsylvania Pump & Compressor Co., Easton, Pa.) Describes a compact, self-contained pumping unit of high efficiency, illustrated with photographs and line drawings. Contains data and tabular material for measuring the flow of water by the V-notch weir method.

Multistage Centrifugal Pumps. 16 p. (Bull. No. 216. Pennsylvania Pump & Compressor Co., Easton, Pa.) Describes and illustrates sleeve and ball-bearing multistage centrifugal pumps, Class OMS and OMSB, for boiler-feed and other industrial service.

Wire Rope

"Wire Saws in Slate and Marble Quarrying." 4 p. (*Wire Engineering* for October-November, 1931. John Roebling's Sons Co., Trenton, N. J.) Describes and illustrates the application of wire saws in the cutting of marble and slate, showing typical layouts of equipment and cutting technique of the wire.



A thought for the holiday season as issued by the St. Louis Quarrymen's Assn.

New Machinery and Supplies

Balanced Hoist Adds to Digging Power of Shovel

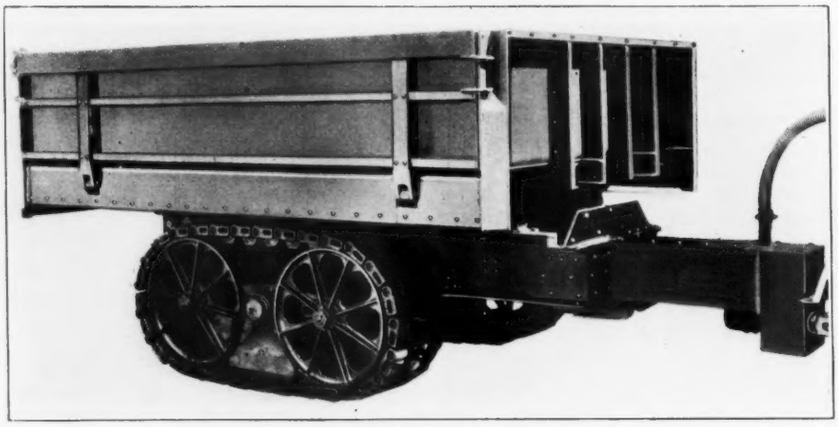
One of the few definitely new features in shovel design to be introduced during the past five years—the Bucyrus-Erie balanced hoist for stripping shovels—is announced after more than a year's experience in the field with several installations.

This new hoist greatly increases the output of the stripping shovel by increasing the dipper size and by increasing the operating speed of the shovel. Its essential parts are a movable counterweight with the necessary guides and tackle, so arranged that as the dipper goes up through the bank in its digging motion the movable counterweight travels downward in its guides, counterbalancing practically all of the weight of the dipper and increasing the amount of digging force available. As the dipper is returned to the pit for the beginning of its next cycle, the counterweight is raised in its guides so that it is again ready to counterbalance the dipper on its way up through the bank. Thus, during the hoisting cycle practically all power of the hoist motors is spent in actual digging because the dipper's weight is counterbalanced by the descending counterweight.

Several important advantages are said to be gained by the use of this hoist, which is built by Bucyrus-Erie Company of South Milwaukee, Wis.

1. Increased digging power, both speed and digging force, without the use of larger electrical equipment.
2. Faster acceleration of the dipper in both digging and returning to the pit.
3. More accurate handling of the dipper—particularly when loading into cars.
4. Less heating of hoist motors and generators—lower average current and longer life.
5. Reduction of peak loads and consequent reduction in the current figure registered by demand meter.

The counterbalanced hoist makes possible the use of much larger dippers without any increase in the size of electrical equipment and without any appreciable increase in the total weight of the machine beyond increased weight of the dipper and dipper contents. The balanced hoist requires no increase in the total amount of counterweight; a weight equal to the movable counterweight would be found on an ordinary stripper as stationary counterweight.



The crawler-mounted, three-way-dump trailer.

Large stripping shovel employing the balanced hoist.

Three-Way-Dump Trailer Controlled by One Lever

The DW-8 three-way dump trailer is the newest wagon to be developed by the LaPlant-Choate Manufacturing Co., Inc., of Cedar Rapids, Ia. It dumps to the rear, to the right, or to the left, the dumping position being controlled by a single lever at the front of the wagon.

The Roadlayer tracks are placed directly under the center of the body, thereby putting the weight on the tracks and not on the tongue or drawbar. Being of short coupling type, the DW-8 wagon can be maneuvered in very small cuts.

These wagons are furnished only in the 8-cu.yd. capacity, and mounted on 15-ton tracks.

The wagon has a body so constructed that it combines the two most vital factors — simplicity and great strength. The sides are made of ¼-in. steel, heavily reinforced at all outside corners with 4-in. channels, while the floor plate is flanged 10 in. on each side.

The side doors open automatically as the body box is raised, and are fully open when the wagon is at a 30-deg. angle. The doors open so that the load is thrown beyond the tracks to prevent materials falling back against the tracks. Doors open the full length of the wagon, folding down to give quick escapement without obstruction which permits dumping any rock that can be placed in box. The dumping mechanism consists of hinged arm castings which are riveted to two angles running the length of the body. The rear arm is hinged to the frame with 2-in. pins, so that when the body is lowered to normal position, it cannot slip sideways. When the body is

dumping the load to the rear, it is securely fastened to the main-frame members by means of large steel heat-treated pins. No matter what position the body is in, whether normal transport position, dumping to one side or the other, or to the rear, it is always securely fastened to the main frame members by these pins.

The side doors are hinged to the body by two steel hinges, and each door is reinforced full length at top, bottom and center by 4-in. channels running the full length. The top channel is reinforced by a flat plate. The rear door can be released at the bottom and hinged at the top when desired.

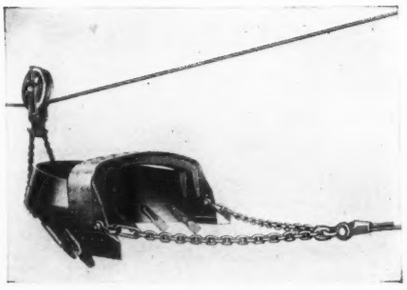
The two-stage, low-pressure, hydraulic-telescoping hoisting unit is securely attached to the wagon frame on a steel trunnion casting which forms an integral base for the cylinder. A ball-and-socket joint is provided at the top of the jack where it comes in contact with the wagon body.

The single hydraulic jack raises the body to either side or rear. The cylinders and the plungers of the jack are made of cast steel heat-treated and ground to size and fitted with oil-ring seals, while the wiper rings keep the cylinders free from grit. There is an air-cushion inside the jack which absorbs any sudden jolts—preventing breakage. The oil pressure comes on the plunger-head where it can exert the greatest force.

A relief pressure valve is provided which permits oil to by-pass when the body reaches full height.

Cranes and Drag-lines Converted to Scrapers

An important recent development in excavating practice centers around the use of a crane or revolving dragline to operate a Sauerman "Crescent" scraper bucket for stripping overburden and moving materials from rivers and pits. The combination of "Crescent" scraper and boom machine offers an efficient means of handling sand, gravel, crushed rock, etc., any distance up to 300 ft., and this combination is recommended as a substitute for a tower excavator when the yardage to be handled is not large enough to justify investment in the latter type of machine.



Bucket and carrier for use with crane or boom drag-line.

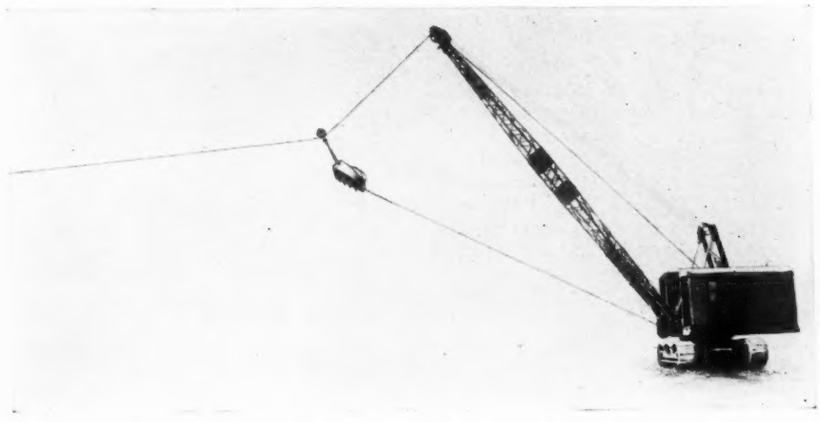
One of the accompanying illustrations shows a "Crescent" bucket attached to a special type of carrier designed by Sauerman engineers, and the other illustration shows this same bucket rigged up with a standard revolving dragline, practically converting this machine into a 300-ft. span tower excavator.

It is said to be relatively easy to rig up any type or make of boom machine for operating a "Crescent" bucket. The line speeds of cranes and draglines are slower than the line speeds of the regular Sauerman drag-scraper machines, it is true, and the rope capacities of the drums are limited; nevertheless, most cranes and draglines can be converted to drag scraper operation without mechanical alterations other than the placing of suitable lagging on the drums. Occasionally it is desirable to provide an outboard support or guy cable for the boom when the digging is particularly difficult.

The regular drag cable is replaced with a longer cable which attaches to the front chains of the scraper bucket. The regular hoist cable also is replaced with a longer cable, which leads over the sheave at the end of the boom and out to a movable tail anchorage. This latter cable serves as an inclined track-line for the carrier and bucket.

There is no swinging and no raising and lowering of the boom; instead, the boom generally is held at its maximum elevation during the entire operation. The track-line is slackened off while the bucket is digging and bringing in a load, but when the bucket arrives at the dumping point, the operator pulls this cable taut by a few revolutions of one drum, thereby raising the bucket into the air. As the bucket is bottomless, it deposits its load automatically when it is lifted.

Among the 14 standard sizes of "Crescent" scraper buckets, there is a size suited to every model and make of boom machine. Further details may be obtained by writing to Sauerman Bros., Inc., 434 South Clinton St., Chicago.

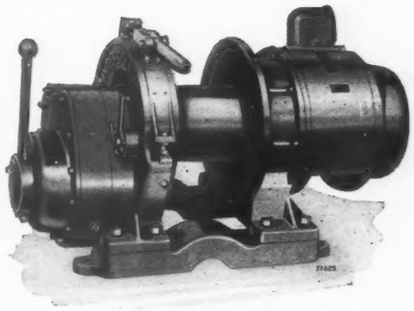


Scraper rigged up with revolving drag-line to provide a reach of 300 ft.

Electric Portable Hoist for Single-Cable Work

Ingersoll-Rand Co., New York, has added to its line of portable hoists a non-reversible, single-drum electric hoist designed for many applications in the mining, contracting, and industrial fields. It is modeled after the company's "Utility" hoists, except that it uses an electric motor and friction clutch instead of an air motor and a jaw clutch.

The new hoist is suitable for all single-cable work within its capacity, such as hoisting timbers, muck, tools, and pipe, hauling and spotting cars, and for single-line scraping. It is made in two sizes. No. 107 is of 7½ hp. and rated at 2,000 lb. pull at 125 ft. per min. It has drum capacity for 400 ft. of ½-in. or 700 ft. of ⅜-in. cable. No. 107L is of like power, but has drum capacity for 800 ft. of ½-in. or 1,400 ft. of ⅜-in. cable. No. 110 has a 10-hp. motor and is rated at 2,000 lb. pull at 165 ft. per min. The drum capacity is the same as for the No. 107. No. 110L has the same power as the No. 110 and the same drum capacity as the No. 107L.



Single-drum electric hoist.

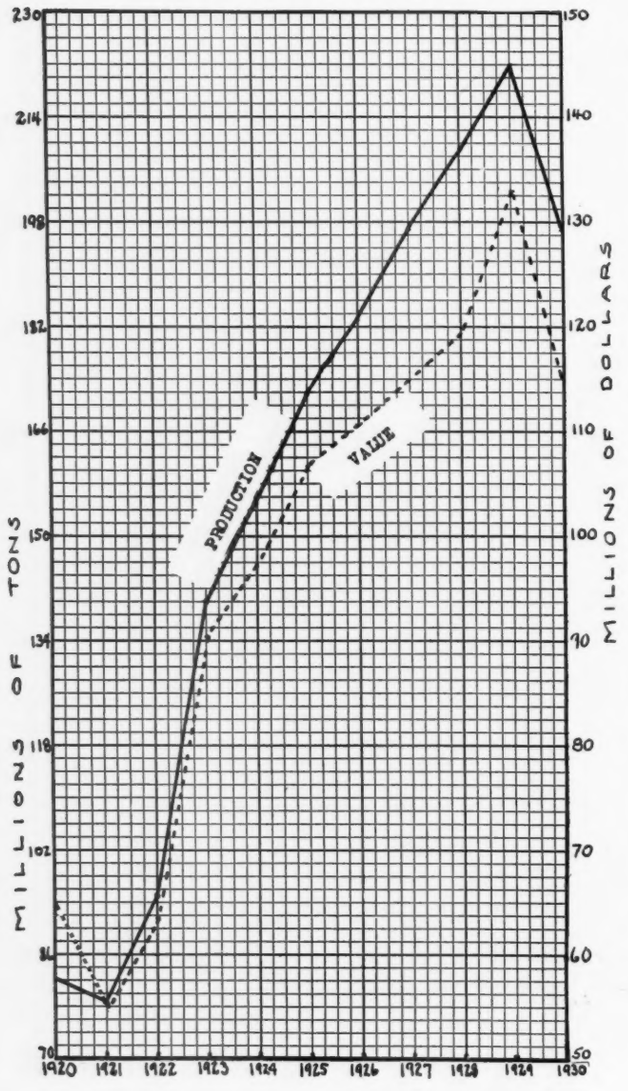
These new hoists are simple, rugged, and compact, are easily operated, have smooth control, and graduation of speed. They have a self-energizing brake for stopping and holding the load and an automatic safety drum lock for added safety when handling suspended loads. Moving parts are protected by dust-proof construction. Bases are drilled and grooved for either column mounting or bolting to a flat surface. Either A.C. or D.C. motors can be furnished.

Sand and Gravel Output 197,051,726 Tons in 1930

THE total production of sand and gravel reported by producers in the United States for 1930, according to statistics made available by the United States Bureau of Mines, Department of Commerce, amounted to 197,051,726 short tons, valued at $115,176,543, a decrease of 11 per cent. in quantity and 13 per cent. in value in comparison with 1929. There were decreases in quantity and value for the total output of all classes of sand and gravel except paving gravel, the output of that material showing an increase of 7 per cent. in quantity though the total value decreased 3 per cent. as compared with 1929. The increase in quantity of paving gravel was probably due to the large amount of road work done in 1930 in the effort to offset to some extent the prevailing business depression and unemployment.

New York and Illinois, with outputs of 20,865,866 and 17,398,693 short tons, respectively, were the largest producers of sand and gravel in 1930. Other states producing more than 11,000,000 tons each follow, in the order of the quantity produced: Ohio, California, Michigan, and Pennsylvania. New York and Pennsylvania led the states in the total value of production in 1930.

About 74 per cent. of the total output of sand and gravel was reported as washed and screened in 1930. Detailed figures on the production and value of sand and gravel in 1930 are given in the accompanying tables.



Production and value of sand and gravel, 1920 to 1930, inclusive.

SAND AND GRAVEL SOLD OR USED BY PRODUCERS IN THE UNITED STATES, 1929 AND 1930, BY USES

Use	1929		1930	
	Short Tons	Value	Short Tons	Value
Sand:				
Glass	2,219,677	$ 3,788,471	1,849,101	$ 3,210,973
Molding	6,195,343	6,410,343	3,336,855	3,547,154
Building	41,161,013	23,309,238	33,599,524	18,850,936
Paving	40,801,991	21,131,731	36,367,468	18,674,649
Grinding and polishing	1,636,464	2,303,652	1,115,915	1,613,022
Fire or furnace	440,679	483,551	258,241	333,727
Engine	2,318,931	1,487,906	1,773,204	1,219,070
Filter	100,081	199,838	80,326	167,947
Other[1]	4,378,875	1,686,627	5,277,984	2,104,075
	99.253,054	60,801,357	83,658,618	49,721,553
Gravel:				
Building	32,448,800	23,813,885	28,271,902	21,346,251
Paving	60,029,164	38,695,207	64,408,274	37,349,936
Railroad ballast[2]	30,840,887	9,525,530	20,712,932	6,758,803
	123,318,851	72,034,622	113,393,108	65,454,990
Grand total	222,571,905	$132,835,979	197,051,726	$115,176,543

[1]Includes some sand used for railroad ballast, fills, etc.

[2]Includes some gravel used by the railroads for fills and other purposes. The quantity of gravel reported as used exclusively for railroad ballast was as follows: 1929, 27,332,529 tons, valued at $8,804,082; 1930, 16,227,543 tons, valued at $5,554,684.

SAND AND GRAVEL SOLD OR USED BY PRODUCERS IN THE UNITED STATES, IN 1930, BY STATES

State	Short Tons	Value
Alabama	1,515,160	$ 901,088
Arizona	402,796	361,326
Arkansas	2,720,756	1,555,408
California	12,604,051	7,354,506
Colorado	929,888	442,303
Connecticut	670,501	446,973
Delaware	74,897	55,193
District of Columbia	[1]	[1]
Florida	496,198	269,161
Georgia	586,929	228,396
Idaho	353,839	169,755
Illinois	17,398,693	8,382,025
Indiana	9,838,757	4,667,771
Iowa	4,521,971	2,599,107
Kansas	3,232,858	1,649,476
Kentucky	2,029,456	1,553,812
Louisiana	3,318,965	2,225,211
Maine	5,215,342	806,545
Maryland	2,678,914	2,330,324
Massachusetts	5,226,669	2,790,436
Michigan	11,389,119	5,161,176
Minnesota	4,590,790	2,274,293
Mississippi	2,001,272	1,050,579
Missouri	5,956,766	4,776,078
Montana	1,523,516	471,555
Nebraska	3,443,715	1,731,230
Nevada	489,726	184,691
New Hampshire	939,767	556,808
New Jersey	5,969,479	5,009,866
New Mexico	314,667	282,360
New York	20,865,866	12,710,172
North Carolina	800,222	437,555
North Dakota	473,184	127,505
Ohio	12,679,854	8,173,741
Oklahoma	2,553,070	1,446,137
Oregon	2,824,519	1,644,243
Pennsylvania	11,012,512	11,107,825
Rhode Island	728.390	283,174
South Carolina	744,378	475,009
South Dakota	2,419,441	931,814
Tennessee	2,182,958	1,436,034
Texas	8,803,929	5,567,127
Utah	1,201,849	613,951
Vermont	313,060	67,369
Virginia	1,470,380	997,227
Washington	5,307,622	2,181,012
West Virginia	2,695,437	2,813,284
Wisconsin	7,082,063	2,801,713
Wyoming	[1]	[1]
Undistributed	2,457,535	1,074,199
Total	197,051,726	$115,176,543

[1]Included in "Undistributed."

Humane Supervision and Its Place in Promoting Plant Safety*

By R. E. COLVILLE
United States Gypsum Co.

IN the operation of a quarry the foreman is in a position similar to that of a man halfway up a ladder—he looks up to the positions above him and looks down reviewing the experiences he himself has passed through. He is able, therefore, to get the point of view of the management and of the men. He knows that an efficient management is sincere in the desire to produce a good quality product economically and without injury to its men. It provides buildings and working areas not only well designed but maintained in first-class condition. Its equipment is guarded and well-maintained and only intelligent, able, desirable workmen are employed. Today most of the men working are the hand-picked, experienced, intelligent workers. Under these conditions all injuries are preventable.

The United States Gypsum Co., in stating its policy, requires that its properties be maintained in the best condition, and places responsibility for carrying out the policy on the men in supervisory capacities. Rules and regulations for safe operation have been developed from several years' experience. These include general requirements for all employees and specific rules for each department. The supervisory employees of the company should set the example of compliance with these rules. Under the plan, discipline is administered for violations of the rules.

The workmen themselves believe the company wants to save money and wants to have a good record to point to. This is true and no denial is made. Some workmen feel that accidents will happen and that, by the law of averages, no man can escape. Over a period of years there is a large enough number of injuries to touch the entire force, yet analysis of the record proves that a small number of men receive the majority of injuries.

It is difficult for some of the workmen to realize that an apparently minor accident is a potential serious injury. They feel "a miss is as good as a mile." These minor accidents, however, occur because of a condition or a repetition of incorrect or unsafe methods.

It is important, if the plan is to succeed, that we overcome such obstacles and misunderstandings. It is good to have rules, but let us not have too many. Let us be sure to enforce the rules we have. Foremen must exercise judgment in the administration of discipline in order that workmen will not fail to report minor injuries for fear of discipline. Discipline the man who violates rules—who insists on doing his work in an unsafe manner—just as we discipline the man who fails to work honestly.

The significance of the housekeeping condition is often overlooked. Some of our past injuries, if correctly reported, would read, "Driver stumbled over tie—foreman didn't appreciate close relation between housekeeping and accidents." Foremen must be on the alert for these conditions, must observe the working areas, the equipment, and the physical and mental condition of the men. Then we must be sure our men are placed in jobs for which they are fitted. We can permit no show of bravado or horse-play.

We have found that the best measure of injuries is the cost; it eliminates theory and personal opinion and, when put before the foreman in the regular operating meetings, gives him a practical measure of his accomplishments. We do not limit our measurement to lost-time injuries only, but consider an injury to be any case which requires the attention of a doctor, regardless of its severity. One of our quarries with 39 men had a cost of $1.15 per $100 pay-roll for injuries in 1930. Its 1931 cost per $100 payroll is $.08, a reduction of 93 per cent. What better measure could we ask?

A good foreman will set a good example which his men can follow. This is as true in handling problems of accident prevention in complying with rules as in matters of cost, where we conserve power, labor and materials. There is little to be gained by simply telling our men once and in generalities that they "must work safely." We must demand safe operation, indicate the correct methods of work then continue to direct our workers.

We have analyzed the injuries which have occurred in the past and from these have devised such specific rules for our local problems as "loaders shall work from side of cars—not between end of car and rock pile." Occasionally an able, experienced, careful worker is injured. In these cases we usually find that his mind was not on the job at the moment, that he was distracted by some one or some thing or that he was not "up to par" physically. We try to keep our men "accident-prevention conscious" by our bulletin-board record of injuries, our warnings on the job, letters and, occasionally, small incentives or prizes for contributions to our accident-prevention plan.

As we observe the effect of these methods on the organization it is clear that the men understand the waste which results from injuries, not only in cost to the company, but to themselves as well. They recognize that the inefficient, wasteful worker—whether his laxity be in production, quality or injuries—will be eliminated from the organization.

An interesting viewpoint of a workman is indicated in the following letter, written by a workman in one of the operations of the Connecticut Quarries Co.

"My opinion of our accident-prevention campaign is as follows: Twenty-three years ago a crusher bedplate fell on my right arm, crushing it from the shoulder down. The chain holding the bed-plate was old, weak and no good. I waited for an hour without help until a doctor came.

"When I was lying down waiting, a freight train came along and the fireman on the train took an old piece of rope and tied it around my arm. They told me later that if my arm had been cut more instead of crushed and if the fireman had not tied the rope around my arm I might have bled to death.

"To-day with the first-aid training I received from the Bureau of Mines I believe I could even help myself in such an accident. Even if I couldn't, a dozen others in the quarry could. I think fifty people gathered around when I got hurt and only the fireman on the train knew what to do.

"Also to-day our chains and machinery are inspected so such an accident could hardly happen now. The posters we have and, mostly, the letters about accidents at the other quarries make everyone think how it might happen to him.

"Anyone with an injury like mine knows how good safety work is. Men working for the company to-day are more fortunate than I was because every other man is watching for their safety."

One foreman states his viewpoint of the development of the accident-prevention movement in this way.

"The first stage was conducted on the order of a political campaign, with speeches and posters, the general endeavor being to sell the workman on safety.

"The second stage might be called the guarding era. While some of the guards applied under this regime were hazardous in themselves, most of them served the purpose well.

"We are now in the third period—we think, talk and act accident prevention rather than simply 'safety first.' We do not rely on guards alone, but appeal rather to the intelligence of workmen. Each man is accountable for his own injury or for contributing to the injury of others."

The accomplishments in the saving of cost and suffering have encouraged many of our men to make worthwhile contributions in accident prevention and in production and have proved the soundness of this plan.

* Abstracted from a paper read at the 1931 National Safety Congress.

Three-Element Feed-Water Control to Meet Needs of Modern Boilers

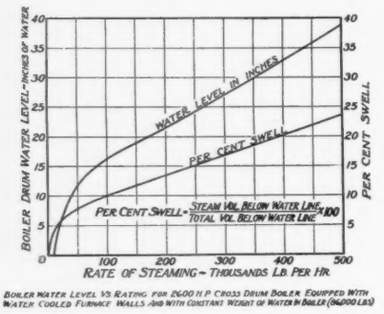
By H. M. HAMMOND
Bailey Meter Co.

IN order to provide adequate feed-water control for modern steam-generating units having relatively small drum-water storage capacity and where rating changes are often very rapid, a quick-acting feed-water-control system is imperative.

During recent years, higher boiler pressures, smaller boiler drums, the extensive use of water-cooled furnace walls, higher rates of steaming, rapidly fluctuating loads and the more common use of fuels burned in suspension, such as pulverized coal, oil and gas, permitting almost instant changes in rate of steam generation, have all contributed to complicate the feed-water-control problem.

Within the past ten years the amount of water storage in a boiler has been reduced from approximately 1 lb. to .2 lb. of water per lb. of steam generated per hour at maximum rating. Furthermore, the modern unit with water-cooled furnace walls has only about one-half as much of its water storage in the drum as compared with the average boiler of 10 to 15 years ago. Due to this change in relative water storage capacity of boiler drums, it would only require about 1½ to 2 min. to evaporate all the water out of a modern boiler drum if something should happen to the feed-water supply when operating at maximum rating. Such a unit permits a feed-water control only about one-tenth the time in which to function upon a change in condition, as compared with the older boilers.

With the increased rate of steaming of modern boilers, a very much greater percentage of the volume below the surface of the water is occupied by steam. This was found to be approximately 24 per cent. in the case of a 2600 hp. cross-drum boiler equipped with water-cooled furnace walls, as indicated by the curves in Fig. 1. Since only 15 to 20 per cent. of the total volume of water in a modern boiler is within the drum at normal water levels, it is evident that the drum water level will be seriously affected by changes in the rate of steaming. Feed-water control for boilers of this type can not operate very successfully in the ordinary manner from an indication of level alone, due to the fact that the water level is not a correct indication of the actual quantity of water in the boiler. A feed-water control for boilers of this type must be extremely fast in operation to keep the level within normal limits during large changes in load. In some cases, the only possible way to maintain the water level within safe operating limits is by means of a control which will maintain a high water level at high boiler ratings, thus providing increased storage so the level will not drop below the water wall tube connections or below the drum when "shrinkage" takes place following a reduction in steaming rate.



BOILER WATER LEVEL VS RATING FOR 2600 H.P. CROSS DRUM BOILER EQUIPPED WITH WATER COOLED FURNACE WALLS AND WITH CONSTANT WEIGHT OF WATER IN BOILER (64,000 LBS)

Fig. 1.

Extreme variations in level may be caused by sudden fluctuations in load. An increase in load, for instance, resulting in a slight drop in steam pressure is immediately followed by increased steam generation due to the heat stored in the boiler water. This will cause the water level in the boiler drum to rise momentarily due to the increased volume of the steam bubbles below the water level. A feed-water regulator operating from water level alone will tend to close during such an increase in boiler rating. Similarly, a sudden decrease in load will result in a drop in boiler drum water level due to the decreased volume of steam bubbles below the surface of the water. This will cause a so-called "single-element" feed-water regulator functioning from water level to increase the flow of water to the boiler. Such a regulator is likely to hunt with fluctuations in the rate of steaming, and is therefore unsuited for controlling feed water flow to a large boiler unit generating high pressure, high temperature steam and operating at several hundred per cent. of rating.

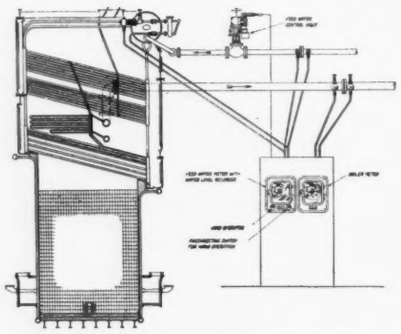


Fig. 2. Three-element feed-water control installation showing the position of the metering equipment.

A "three-element" feed-water-control system has recently been developed to meet the stringent requirements of present day boilers. The three elements from which this control is operated are (1) steam flow from the boiler, (2) feed-water flow to the boiler and (3) water level in the boiler drum In order to nullify the effect of "swell" and to maintain the rate of feed water input more nearly equal to the rate of steam output, this control functions primarily from steam flow but is modified slightly by water level when necessary, to hold the level within the desired limits.

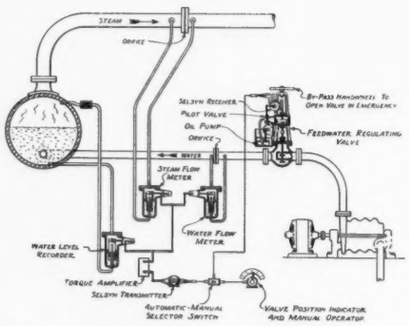


Fig. 3. Diagrammatic lay-out of three-element Selsyn hydraulic feed-water control.

The control is based on metered results as indicated in Fig. 2. A combined recorder for feed water flow and boiler water level, and an adjacent recorder for boiler steam flow, which may be the steam flow mechanism of the standard Bailey boiler meter, supplies complete operating information for boilers which require careful feed-water control. The three elements of steam flow, feed-water flow, and boiler-water level are coördinated by means of linkage, as indicated diagrammatically in Fig. 3, to operate a Selsyn sending device through a torque amplifier.

The linkage may be adjusted so that the water level in the drum is permitted to vary during normal operation, in accordance with the "swell" corresponding to the boiler rating. This insures maintaining a more nearly constant weight of water in the boiler instead of a constant water level. A low water level at low-boiler ratings provides room for expansion with increased rating thereby tending to eliminate the possibility of moisture carry over. A correspondingly high boiler-water level at high ratings also provides protection against a sudden loss of load with the consequent shrinkage of volume. Such an adjustment insures carrying sufficient water in the boiler drum to seal the water-cooled furnace wall circulating tubes at all times. The system may also be adjusted to maintain a substantially constant water level in the drum at all times. This is usually desirable in the case of extremely high pressure boilers due to the fact that the specific volume of the steam approaches that of the water so that the "swell" becomes negligible.

The Selsyn method of electrical

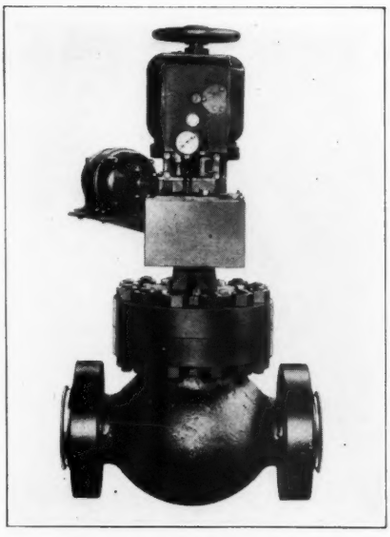


Fig. 4. Control valve designed for 1,600-lb. pressure service.

transmission is used as the connection between the flow meters, which are the primary source of control, mounted on the boiler panel board, and the feed-water regulating valve. A torque amplifier, controlled by the movement of the connecting linkage between the three elements, turns the Selsyn sending unit at a rate proportional to the requirements for feed water. The receiving Selsyn motor, mounted on the flow regulating valve in the feed water line, accurately follows every movement of the sending Selsyn and in doing so moves a pilot valve in the flow regulating valve from its neutral position. This applies oil pressure to the proper side of the operating piston which opens or closes the valve to secure the required rate of flow. As the piston moves, the frame or stator of the receiving Selsyn is rotated in such a way that the pilot valve is returned to its neutral position and the flow regulating valve is held in the new position.

The Selsyn hydraulic feed water control valve, shown diagrammatically in Fig. 3, is provided with its own motor driven oil-pumping unit mounted directly on the valve, resulting in a self-contained unit. This eliminates the necessity of extensive oil piping and the possibility of undesirable oil leakage.

While boilers operating at pressures from 1,200 to 1,400 lb. per sq. in. do not seem to be troubled with level variations due to fluctuations in rate of steaming, the small drum volumes which, for economical reasons, are included with these boilers, require feed-water control which is fast in action. The increased amount of power required to operate high pressure feed control valves and the decrease in sensitivity of ordinary methods of level indication with increased pressure, requires amplification of power between the level indicators and the valve. The Selsyn hydraulic system described, admirably meets these requirements by providing a control which responds quickly and accurately to both small and large changes. Sufficient power is always available for operation of the valve.

A valve-position indicator may also be placed on the operating panel board below the meters so that the operators may know the position of the feed-water-control valve at all times. A hand control is also incorporated which permits operation of the control valve independently of the automatic control. This only involves the operation of a switch, after which the valve may be positioned manually through the use of a knob on the valve position indicator.

A Bailey three-element feed-water-control valve, designed for 1600-lb. pressure service, is shown in Fig. 4. It is a fully-balanced tight-seating valve similar to the one used in the standard Bailey thermo-hydraulic feed-water regulator. It has a valve cage which is easily removable for inspection or grinding and which is provided with ports to give a straight line flow characteristic.

Steam flow and feed-water flow-meter charts representing the operation of this Selsyn hydraulic three-element feed-water control are shown in Fig. 5. From these charts it will be noted that the feed water flow responds simultaneously to changes in the ratio of steam flow. The boiler water level is held constant in this case, since this boiler operates at 1300-lb. pressure.

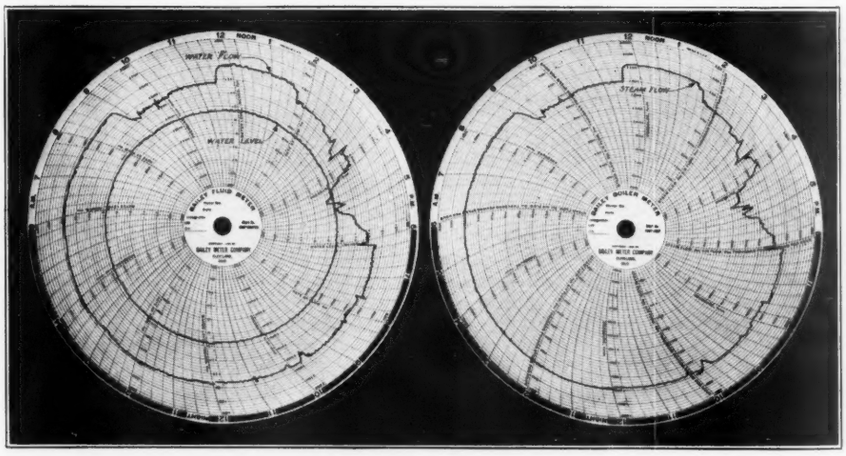


Fig. 5. Chart records representing the operation of the three-element feed-water control.

Cement Co. Entitled to Collect Truck Liability

It is well-settled law that an insurance company is relieved from liability for payment of insurance, if the holder of the policy violates any provision in the contract. On the other hand, the courts, when construing the legal construction of an insurance policy clause, will not read into it certain restrictions or a forfeiture not clearly contained in the contract.

For example, in Ash Grove Lime & Portland Cement Co. *v.* Southern Surety Co., 39 S. W. (2d) 434, it was disclosed that the cement company had issued to it what is known as a "fleet" insurance policy intended to cover all motor vehicles operated and owned by the company. The policy contained a clause that if the insured purchased new vehicles it should immediately notify the insurance company. The cement company purchased and began operating a new motor-truck and failed to notify the insurance company. The driver of the new vehicle had a collision which resulted in serious injury. The injured person sued the cement company to recover damages and the insurance company refused to pay the claim on the grounds that the cement-company officials had violated the terms of the insurance policy which required that the purchase of a new vehicle be reported immediately. Notwithstanding this argument the Court held the insurance company liable, and said:

"The entire clause has to do with the coverage of new automobiles acquired during the policy term. The policy was what is referred to as a 'fleet' automobile policy and must be construed as covering all cars owned and operated by insured during the policy year, and to cover all new cars immediately upon their acquisition, thus avoiding the possibility of an accident with an after-acquired car not covered and without the formality of applying for additional coverage. . . We think it is clear the provision for reporting the acquisition of a new car was not for the purpose of allowing the insurer to say whether or not it was willing to extend coverage to such car, but rather for the purpose of covering all cars owned or operated during the policy year. . . As stated, the policy contains no forfeiture provision for failure to perform the condition. It is well settled that if parties do not insert a forfeiture clause in the policy, the Courts may not read such a clause into it."

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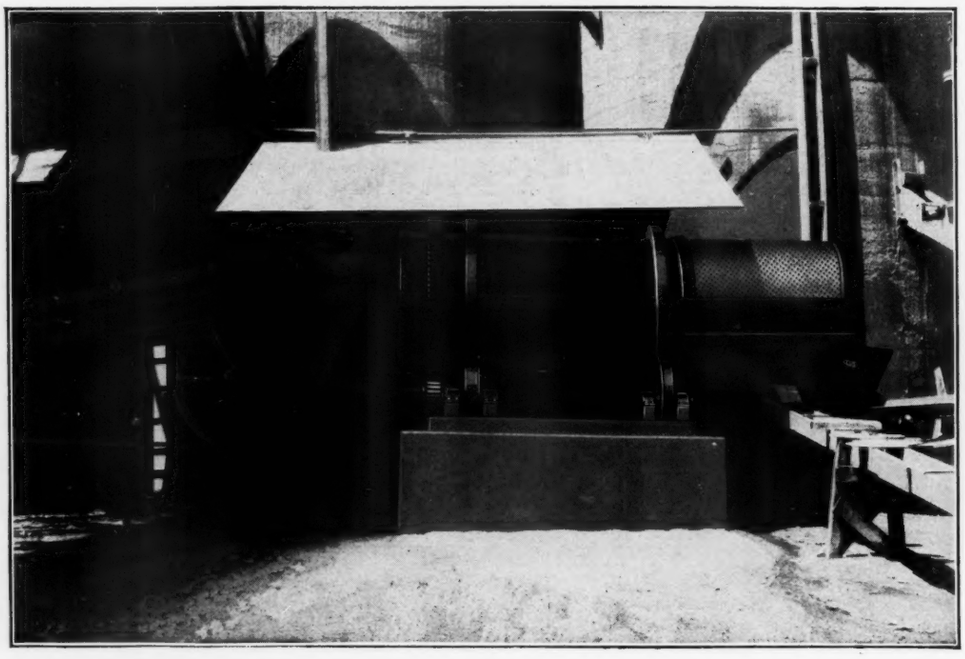

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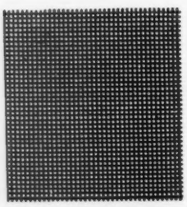
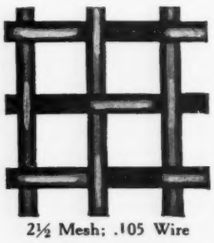


40 Mesh: .0135 Wire



2½ Mesh: .105 Wire

12 Mesh: .047 Wire

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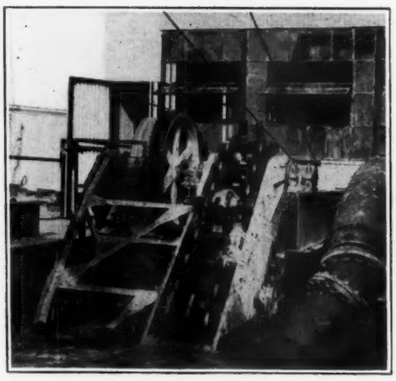
A 50-Foot Eagle "Swintek" in New Curtis & Hill Plant



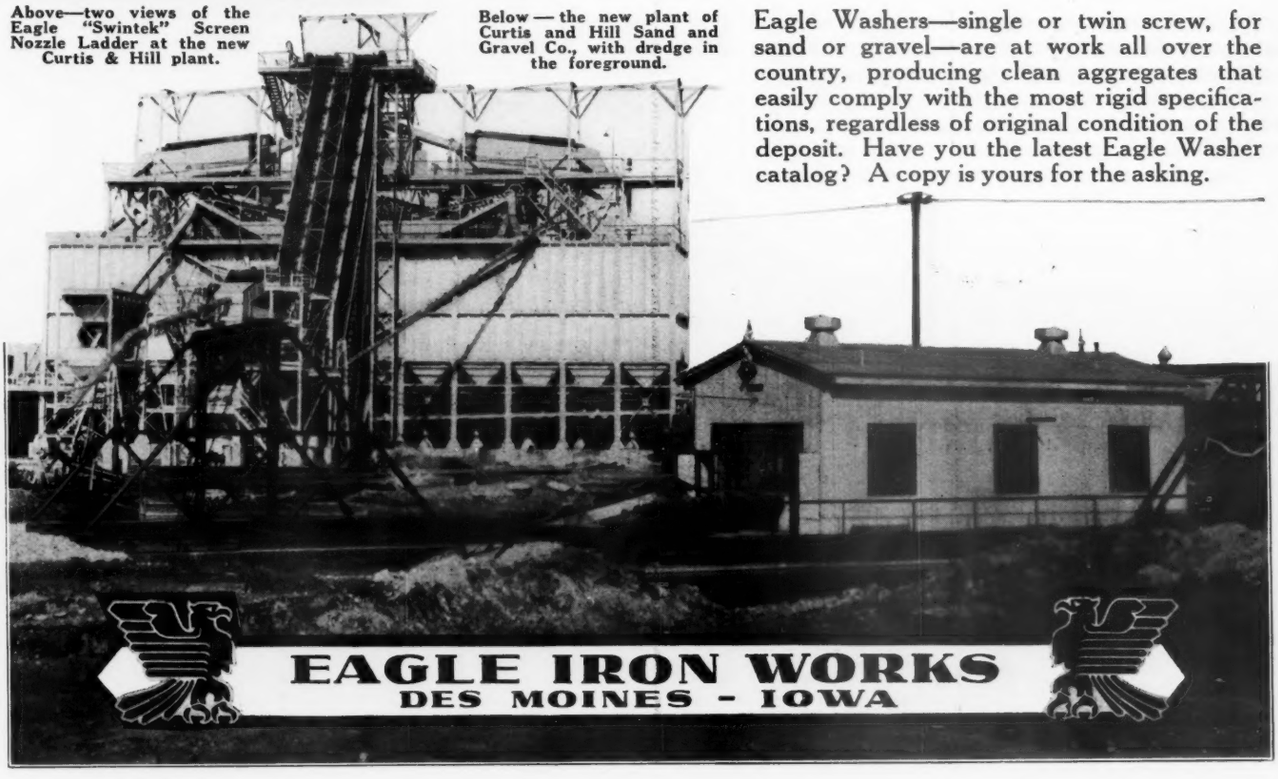
The new plant of the Curtis & Hill Sand and Gravel Co., at Morrisville, New Jersey, is considered one of the best examples of efficient design among the new large plants.

It is significant that a 50-foot Eagle "Swintek" Screen Nozzle Ladder is included in the dredge equipment of this plant.

Why? Because it assures continuous production, because the cutting and agitating action of the ladder insures a steady flow of solids. The Eagle "Swintek" tears loose the aggregate that is too tightly packed to be workable by a plain suction pipeline, and the ladder removes boulders and deposits them in worked-over territory.

If you operate a sand and gravel dredge, the Eagle "Swintek" can greatly increase its efficiency. Let us show you how. Write for full particulars.

Above—two views of the Eagle "Swintek" Screen Nozzle Ladder at the new Curtis & Hill plant.

Below — the new plant of Curtis and Hill Sand and Gravel Co., with dredge in the foreground.

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